HE PERFECT PHONE? SAMSUNG GALAXY S10+ REVIEWED

apc

April 2019
Issue 466

YOUR EXPERT GUIDE TO TODAY'S TECH

NOW INCORPORATING PC & TECH AUTHORITY

THE 2019 BACKUP GUIDE

NEVER LOSE A FILE AGAIN!

* DISCOVER THE EXPERT WAYS TO MAKE YOUR FILES SAFE
* SAVE YOUR WINDOWS AND MAC SETUP
* IMMUNISE YOUR PC OR MAC AGAINST DISASTER

2019 RAZER BLADE STEALTH

IS RAZER THE NEW LAPTOP KING? REVIEWED

BEST APPS GUIDE

EVERYTHING AWESOME FOR WINDOWS, LINUX & RASPBERRY PI

HOW-TOs

ANDROID VIDEO GUIDE * SMART REDDIT TIPS * DECLUTTER YOUR MAC'S MENU BAR * TRACK YOUR PERSONAL FINANCES * FIX DISTORTION IN YOUR PHOTOS

AMD STRIKES BACK!

MUST-HAVE MONITOR TECH

HIGH REFRESH vs. HIGH DYNAMIC RANGE vs. HIGH RESOLUTION

HOT TECH REVIEWS

AMD RADEON VII & NVIDIA 1660TI

PLUS TP-LINK AX6000 > WD BLACK 750N SSD > ACER XV273K MONITOR > MICROSOFT SURFACE HEADPHONES > ASUS MAXIMUS XI APEX & MUCH MORE

TURE
AUS$9.95 INC GST
NZ$10.90 INC GST
PRINT POST
APPROVED: 100000179
ISSN: 0728-4415
04
13006 001362

NBN SMB Solution for Ethernet WAN (FTTP, HFC, Fixed Wireless, Satellite)

DrayTek Aust & NZ
www.draytek.com.au

Vigor2926 Series

Dual-WAN broadband router with Gigabit LAN, Security Firewall, 802.11ac (AC2000) Wi-Fi, VoIP and 50 x VPN tunnels including 25 x SSL-VPN tunnels

- Dual Gigabit Ethernet WAN ports for Failover and Load-Balancing and High Availability mode
- Two USB 2.0 ports for connection to two 3G/4G LTE USB mobiles, FTP server and network printer
- 4 x Gigabit LAN ports with multiple subnets and 50,000 NAT sessions
- 50 x VPN tunnels (including 25 x SSL-VPN tunnels) with comprehensive secure protocols
- Fast VPN throughput, VPN load-balancing and backup for site-to-site applications
- 16 x VLANs for secure and efficient workgroup management
- IPv6 & IPv4
- IEEE 802.11ac (AC2000) wireless Access Point; dual band; up to 1.7Gbps throughput (Vac/ ac model)
- 4G LTE SIM card slot (L model)
- VoIP with 2 x FXS and 1 x FXO Line Port (V model)
- Object-based SPI Firewall and CSM (Content Security Management) for network security
- Supports VigorACS 2 Central Management System for remote management
- Central VPN Management for 8 remote Vigor routers
- Central AP Management for deployment of multiple wireless VigorAPs
- Free Smart Monitor Network Traffic Analyzer for 30-nodes

Vigor2952 Series

Dual-WAN broadband Fibre Router with Security Firewall, 4 x PoE LAN ports (power budget up to 60 Watts), 100 x VPN tunnels including 50 x SSL-VPN tunnels

TAIWAN EXCELLENCE 2016

100x VPN

- 1 x Gigabit Ethernet/SFP combo WAN port, 1 x Gigabit Ethernet WAN port
- Multi-WAN Load Balancing & Failover and High Availability mode
- 4 x Gigabit PoE Ethernet LAN ports with 60,000 NAT sessions (P model)
- Complies with 802.3at Power over Ethernet Plus (P model)
- Supports PoE power up to 30 watts for each port, and total PoE power budget up to 60 watts (P model)
- 1 x USB port (USB3.0) support 3G/4G LTE USB mobile
- 100 x VPN tunnels including 50 x SSL-VPN tunnels with Central VPN Management
- VPN Load Balance and Redundancy
- Object-oriented Firewall with Content Security Management and QoS
- IPv6 & IPv4
- Multi subnet WAN/LAN through 802.1Q
- 1 x USB port (USB2.0) support file sharing, external storage, network printer or thermometer
- Central AP Management; Central Switch Management; Smart Monitor Traffic Analyzer
- Supports VigorACS 2 Central Management System for remote management

Vigor2133 Series

Broadband router with Gigabit LAN, SPI Firewall, 802.11ac (AC1200) Wi-Fi, VoIP and 2 x VPN tunnels (convertible to 2 x SSL-VPN tunnels)

2x VPN

- 1 x Gigabit Ethernet WAN port
- 2 x USB ports for 3G/4G access, FTP server and Network printers
- Load Balance and Failover functions for WAN and USB 3G/4G WAN
- 4 x Gigabit Ethernet LAN ports with 30,000 NAT sessions
- IPv6 & IPv4
- NAT throughput over 450Mbps
- Object-based SPI Firewall, Content Security Management (CSM) and QoS
- 2 x VPN tunnels; convertible to 2 x SSL-VPN tunnels
- 802.11ac (AC1200) Wi-Fi, up to 300 + 867Mbps speed
- SIP VoIP (2 x FXS) for Vac model
- Central AP Management for deployment of up to 2 wireless VigorAPs
- Supports VigorACS 2 Central Management System for remote management
- 2 years back to base warranty

i-LAN TECHNOLOGY

i-LAN Technology Pty Ltd trading as DrayTek Aust & NZ

www.i-lan.com.au (02) 9838 8899 sales@i-lan.com.au

www.draytek.com.au

© Copyright 2019 i-LAN Technology Pty Ltd. All rights reserved.

apc

Future Publishing Australia, PO Box 1077 Mount Street, North Sydney, NSW 2059
Tel: (02) 9955 2677 **Fax:** (02) 9955 2688
Email: apcmag@futurenet.com
Web: www.apcmag.com
Subscription enquiries: Please call CRM: (02) 8227 6486

Editorial
Editor: **Ben Mansill**
Senior Journalist: **Shaun Prescott**
Journalist: **Joel Burgess**
Journalist: **Harry Domanski**
Journalist: **Stephen Lambrechts**
Journalist: **Sharmishta Sarkar**
Creative Director: **Troy Coleman**
Designer: **Sharnee Swinnerton**

Contributors
Anthony Agius, Daryl Baxter, Alex Blake, Ian Evenden, Anthony Fordham, Dan Gardiner, Craig Grannell, David Hollingworth, Chris Szewczyk, Jeremy Laird, Carrie Marshall, James O'Connor, Nick Peers, Les Pounder, Nick Ross, Mayank Sharma, Zak Storey, Tom Sykes, Mark Williams, Darren Yates.

Photography
All copyrights and trademarks are recognised and respected

Advertising
Group Advertising Manager: **Cameron Ferris**
cameron.ferris@futurenet.com

Management
Managing Director: **Neville Daniels**
Sales Director: **Paul Marttila**

Printed by Blue Star PRINT (NSW)

Distributed in Australia and NZ by Gordon and Gotch
www.gordongotch.com.au

ISSN 0728-441

We are committed to only using magazine paper which is derived from responsibly managed, certified forestry and chlorine-free manufacture. The paper in this magazine was sourced and produced from sustainable managed forests, conforming to strict environmental and socioeconomic standards. The manufacturing paper mill holds full FSC (Forest Stewardship Council) or PEFC certification and accreditation

All contents © 2018 Future Publishing Australia or published under licence. All rights reserved. No part of this magazine may be used, stored, transmitted or reproduced in any way without the prior written permission of the publisher. Future Publishing Limited (company number 2008885) is registered in England and Wales. Registered office: Quay House, The Ambury, Bath BA1 1UA. All information contained in this publication is for information only and is, as far as we are aware, correct at the time of going to press. Future cannot accept any responsibility for errors or inaccuracies in such information. You are advised to contact manufacturers and retailers directly with regard to the price of products/services referred to in this publication. Apps and websites mentioned in this publication are not under our control. We are not responsible for their contents or any other changes or updates to them. This magazine is fully independent and not affiliated in any way with the companies mentioned herein.

If you submit material to us, you warrant that you own the material and/or have the necessary rights/permissions to supply the material and you automatically grant Future and its licensees a licence to publish your submission in whole or in part in any/all issues and/or editions of publications, in any format published worldwide and on associated websites, social media channels and associated products. Any material you submit is sent at your own risk and, although every care is taken, neither Future nor its employees, agents, subcontractors or licensees shall be liable for loss or damage. We assume all unsolicited material is for publication unless otherwise stated, and reserve the right to edit, amend, adapt all submissions.

Privacy statement
If you provide information about yourself this will be used to provide you with products or services you have requested. We may supply your information to contractors to enable us to do this. Future Publishing Australia will also use your information to inform you of other publications, products, services and events. Future Publishing Australia may also give your information to organisations that are providing special prizes or offers and are clearly associated with the Reader Offer. Unless you tell us not to, Future Publishing Australia may give your information to other organisations that may use it to inform you of other products, services or events. If you would like to gain access to the information Future Publishing Australia holds about you, please contact us.

FUTURE
Connectors. Creators. Experience Makers.

Future plc is a public company quoted on the London Stock Exchange (symbol: FUTR)
www.futureplc.com

Chief executive **Zillah Byng-Thorne**
Non-executive chairman **Peter Allen**
Chief financial officer **Penny Ladkin-Brand**

Tel +44 (0)1225 442 244

Losing it

Keeping your stuff safe.

Backing up is a necessary chore, and I know we're all aware that it must be done. I'm also fairly certain that very few of us apply the levels of care to the task that we should. Now, I'm not talking to you, the Sys Admins that read *APC* — your good habits are soaked in. I've also run into many readers of *APC* and *PCTA* in the past that have adopted an obsession with good backup practice. It's truly admirable.

My hope is that this month's Backup Superguide will spur on some that may need to take a fresh look at what and how they back up. Don't view it as a big and daunting project, perhaps just skim over the sections and identify one area that may need attention and get on top of that. Maybe you'll get on a roll and soon you'll be able to feel a lot safer about your files and system.

I once lost almost every important file I had, including most of my photos, when a hard drive in RAID 0 failed, irretrievably taking with it all my important files. Since that day (which, I'll add, was almost 20 years ago) I've been pretty strict about backing up personally.

How good is it to see AMD back in the game with a competitive high-end video card? Just fantastic. We're seeing right now exactly why competition is so important in the graphics market. Nvidia's pricing for the 20-series cards is just astonishing. $2,000 for a 2080Ti is a bridge too far. Look at the relatively swift and radical moves Intel was forced to make when Ryzen hit. Better products at lower prices, and while it's a little disappointing the new Radeon VII can't quite match the 20180Ti for raw performance, its 16GB of RAM may make it the only choice for some.

Interestingly, AMD's Radeon VII is itself rumoured to be a reactionary product, with it being a bastardised version of its professional M150 Radeon Instinct card. It is said that AMD was able to get the Radeon VII designed and manufactured quickly, in response to Nvidia's high pricing for the 20-series.

In *APC* news, as you'll discover in a few pages, we're adding a new opinion column. Regular writer Chris Szewczyk pens his first column for *APC* this issue and I know I'm keen to read his thoughts every month. Chris covers all areas of tech and has worked across the industry, he's as passionate as he is knowledgable, so his insight is welcome here.

After much thought and many bad ideas, we've decided to name Chris' new column Two Bits. Long-time readers of *APC* may recognise that name, it was what we called our opinion columns for a great many years in the early days. It's a good name, and it's back. ■

BEN MANSILL
EDITOR
ben.mansill@futurenet.com

Contents

Issue 466 April 2019

44

THE 2019 BACKUP GUIDE

NEVER LOSE A FILE AGAIN!

* DISCOVER THE EXPERT WAYS TO MAKE YOUR FILES SAFE
* SAVE YOUR WINDOWS AND MAC SETUP
* IMMUNISE YOUR PC OR MAC AGAINST DISASTER

» features

44 THE 2019 BACKUP GUIDE
Never lose a file again.

62 25 OF THE BEST WINDOWS 10 APPS FOR 2019
We scoured the Microsoft Store to find the best apps that will improve the way you use your Windows 10 PC.

68 TOP 100 LINUX TOOLS
Take a stroll through the open source garden as we pick the best apps, tools and utilities available to all Linux kind.

» technotes

10 NEWS
The latest developments in the tech world.

14 NUMBER CRUNCH
The numbers behind the big tech news.

15 TECH BRIEF
The evolution of existing technology.

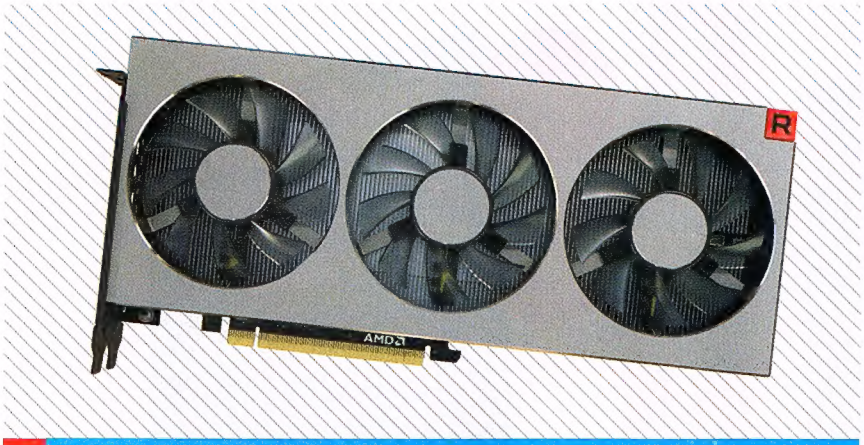
16 GADGETS
Hot tech gear we want to own.

18 HOW IT'S DONE
All the small things inside the new 11-inch iPad Pro.

19 END USER
Shaun Prescott wonders if YouTube's recent changes to protect children really help.

21 TWO BITS
Did Nvidia misjudge its Turing pricing strategy?

"It's got all the important features, looks good and performs so well that you likely won't need to buy other networking equipment for a long time to come."
TP-Link Archer AX6000 review, page 32



26 AMD RADEON VII

31 ACER XB273

33 ASUS RT-AX88U

30 ASUS MAXIMUM XI APEX

» the lab

22 HEAD TO HEAD
22 High refresh vs. High Dynamic Range vs. high resolution.

24 LATEST REVIEWS
24 Razer Blade Stealth
25 WD Black 750N SSD
26 AMD Radeon VII
28 MSI GeForce GTX 1660Ti Gaming X
30 Asus Maximus XI Apex
31 Acer XB273
32 TP-Link Archer AX6000
33 Asus RT-AX88U
34 TT RGB Watercooled RAM
34 Elgato Thunderbolt 3 Pro dock
35 TP-Link Deco M4 mesh
36 Samsung Galaxy S10+

38 SOFTWARE REVIEWS
38 Windows
39 Apple macOS
40 Apple iOS
42 Android
43 Linux

76 PC BUILDER
76 System News
77 Market Watch
78 Blueprint
80 PC Builder Masterclass

» how to

84 QUICK TIPS
84 We fix your tech problems.

88 TUTORIALS
88 Fix distortion in your photos
92 Smart Reddit tips
94 Declutter your Mac's menu bar
96 How to track your personal finances

100 MASTERCLASSES
100 Creating a classic system demo
102 Android video playback
104 Python loops and functions

» downtime

106 GAMING NEWS
The latest in gaming news.

108 GAMES REVIEWS
High-performance playtime.

112 GAME CHANGER
Fallout's rise to glory.

114 CHIP CHAT
Quirky news from the world of geekdom.

TURN THE PAGE FOR YOUR EXCLUSIVE FREE SOFTWARE OFFERS

exclusive software

» HOW TO DOWNLOAD YOUR FREE FULL-VERSION PROGRAMS

ISSUE 466, APRIL 2019

Please note that these exclusive *APC* magazine downloads will only be available for a limited time, from **25/03/2019 to 12/05/2019**

PERFECT YOUR DIGITAL PHOTO LIBRARY

ORGANISE, OPTIMISE AND EDIT WITH ASHAMPOO PHOTO COMMANDER 15

FULL VERSION WORTH $12

The new Ashampoo Photo Commander 15 is the comprehensive solution to view, edit and organise your photos, geotagging included! Bring order to your photo library, batch-optimise multiple files at once or create and design your own calendars, greeting cards and slideshows with ease. Control and navigate through your slideshows on your PC while the slides appear on an external display or beamer! With just a few clicks, beginners, amateurs and professionals alike will achieve stunning results.

DOWNLOAD LINK: www.ashampoo.com/lpa/apc

KEEP YOUR DRIVE SPICK AND SPAN

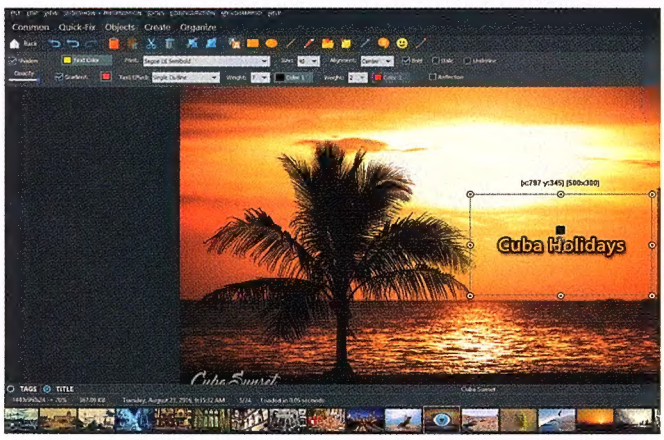
ORGANISE ALL YOUR FILES WITH ABELSSOFT FILE ORGANIZER

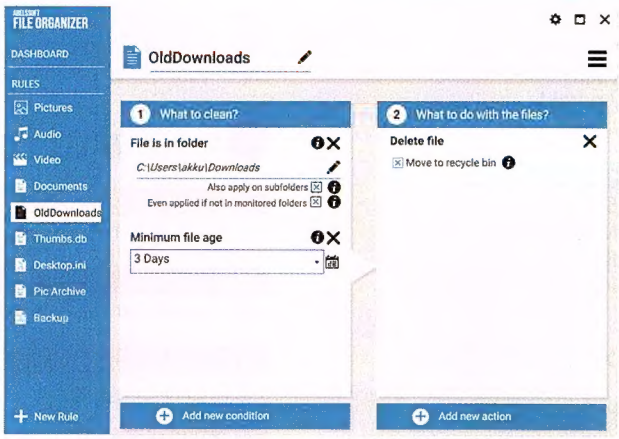
FULL VERSION WORTH $25

Downloads, new photos, current documents: For many users, these files first end up directly on the desktop. This is where the naked chaos soon breaks out. The new Abelssoft File Organizer ensures order – fully automatically. File Organizer creates its own icon on the desktop: if the user drags a file onto this icon it will be processed automatically according to previously set rules. Depending on the file type or certain letter sequences in the file name, the files can be moved to a certain folder and thus automatically sorted away. Files can also be compressed, copied or deleted automatically.

DOWNLOAD LINK: www.apcmag.com/exclusives

DOWNLOAD ZIP PASSWORD: April19a (note this is case-sensitive)





DISCLAIMER Future Publishing is not the licensor of the exclusive software or any documentation included with it. Rather, Future is merely a distributor of the software, and your use of the software is subject to any accompanying third-party licence terms. You must carefully read and comply with any such third-party licence terms, together with all instructions and README files that come with the software. Accordingly, to the maximum extent permitted by law, all software is provided by Future 'as is' and without warranty, either express or implied, and Future will not be liable for any damage that you may incur as a result of using any software downloads. You should back up any important system and data files before using any downloaded software. We recommend that you do not use the exclusive software on a production machine. Nothing in this disclaimer excludes any warranty that may be implied by statute, which may include the Trade Practices Act. While we have taken all reasonable steps to check the software downloads for viruses, we cannot guarantee that it is free from viruses or other harmful code and you should check each download using a virus scanner complete with the latest antivirus updates before use.

ROG RAMPAGE VI EXTREME OMEGA

THE EMBODIMENT OF POWER

Optimized Power Solution

16 power stages are strategically paired to rapidly deliver the currents high core counts processors demand and they're kept cool by a massive heatsink assembly topped with dual fans.

Intelligent Control

With just a click, 5-way optimization delivers automatic overclocking and cooling profiles that are tailored for your rig, or alternatively use comprehensive UEFI BIOS settings for full manual control.

Ultra-Fast Networking

GameFirst V allows your rig to prioritize uncompressed 4K gameplay streaming with uninterrupted lag in your gaming sessions, while enjoying lightning-fast data throughput with onboard 10Gbps Ethernet.

technotes

» INSIDE APC

Inside APC

Find out all about *APC*'s editorial policies, test practices, how to read the benchmark results, and more.

APC is Australia's oldest consumer technology magazine – having been consistently in print for over 35 years, since our first issue way back in May 1980 – and we take that heritage and responsibility very seriously. While our focus is obviously on the personal computer – it's in our name, after all – the very definition of the PC has changed and shifted markedly since the early 1980s. As such, we touch on many other areas of tech, too, from smartphones and apps to peripherals, accessories, online services and beyond. We have two main goals: to track down the best of modern tech and also to help our readers make the most of it.

We're also an open church in terms of platforms. We know most people aren't wed to a single brand's products and use a variety of devices. And, like you, *APC*'s journalists want to know what's good in tech – no matter what platform it resides on.

INDEPENDENT REVIEWS

Championing technology doesn't mean we're unrelenting yes-men and -women, however, and *APC* aims to be as objective as possible in all our coverage. That means identifying the best products from multiple perspectives – the best performance, best value and best features and, ideally, the products that offer the best mix of these three.

As a matter of policy, reviews published in *APC* are not shared with product-makers prior to print. We will contact vendors under certain conditions; for example, if we have a problem testing a product that seems to indicate it may be faulty, or to invite a vendor to clarify how a particular feature works. If an *APC* reviewer has any potential conflicts of interest involving a brand, the review will always be assigned to another writer.

LABS TESTING

Despite being a small magazine with limited resources, *APC* still strives to conduct the most rigorous, objective scientific tests and benchmarks we can so as to make our reviews as unbiased as possible. We use a variety of tools and programs for this, including many freely available benchmark suites for assessing media encoding, general system performance, gaming and battery life.

In most cases, for the benchmark results published in *APC*, you can assume that higher is better. There are certain tests that deviate from this rule where the opposite is true; in those cases, we've flagged the results with a note explaining as such.

We use both tables and graphs for displaying results; the latter are our preference due to their ease-of-readability, but tables are more compact, so we use these in cases where thoroughness is preferred.

AOC

G1 SERIES GAMING

EXPAND YOUR WORLD

	C24G1	C27G1	C32G1	CQ32G1
Panel Size	23.6"	27"	31.5"	31.5"
Resolution	1920 x 1080	1920 x 1080	1920 x 1080	2560 x 1440
Refresh Rate	144Hz	144Hz	144Hz	144Hz
Response Time	1ms	1ms	1ms	1ms
High Adjustable	Yes	Yes	No	No
Connectivity	VGA, HDMI 1.4 x 2, DisplayPort 1.2, Earphone Jack	VGA, HDMI 1.4 x 2, DisplayPort 1.2, Earphone Jack	VGA, HDMI 1.4 x 2, DisplayPort 1.2	HDMI 1.4 x 2, DisplayPort 1.2
Game Features	FreeSync & Game Color	FreeSync & Game Color	FreeSync & Game Color	FreeSync & Game Color
Eye Care Tech	Flicker Free & Low Blue Mode	Flicker Free & Low Blue Mode	Flicker Free & Low Blue Mode	Flicker Free & Low Blue Mode

https://au.aoc.com/

technotes

» HARRY DOMANSKI WITH THE NEED TO KNOW NEWS

Image credit: Hughes Entertainment/20th Century Fox

Macaulay Caulkin is now a video game producer

SOMETIMES IT PAYS TO BE A MEGAFAN.

You may remember Macaulay Culkin as the cute kid who played Kevin McAllister in *Home Alone* thirty years ago, but his recent obsession with the Sega Genesis title *ToeJam & Earl* has netted him the role of executive producer on an upcoming title. HumaNature, the studio developing upcoming game *ToeJam & Earl: Back in the Groove*, noticed Culkin's love of the series and invited him on board.

Mozilla's Common Voice library could lead to more voice-enabled devices

GIVING EVERYONE A VOICE.

Mozilla's Common Voice Library project – an open source collection of human voices speaking in 18 different languages – has grown significantly in the last year and now comprises of over 1,400 hours of recorded audio. The project is intended to help independent and small developers (i.e. not Google, Amazon or Apple) create their own voice assistants and voice-enabled devices.

Retailers facing more bot attacks than ever

The most likely credential stuffing attack victim.

From May to December of 2018, hackers directed credential abuse attempts at retail sites more than 10 billion times according to new research from cybersecurity company Akamai.

The firm's 2019 *State of the Internet* report sheds light on the fact that the retail industry was the most targeted segment by hackers while also highlighting the prevalence of API-call traffic on the web and the misrepresentation of Ipv6-based traffic. Akamai studied the credential abuse technique known as credential stuffing for its report and examined how hackers have begun to employ botnets to steal login credentials from retail websites.

These stolen credentials are used to compromise accounts from which hackers acquire retail merchandise and resell it for cash. According to the report, the AIO bots deployed by hackers are multi-function tools that enable quick purchases by leveraging credential stuffing and a number of evasion techniques. For example, a single AIO bot can target over 120 retailers at the same time. Akamai noted in particular that media streaming, financial, and travel services were more likely to be targeted.

AMD's new FreeSync 2 HDR demo shows off 'next level' tech for gaming displays

OASIS DEMO ILLUSTRATES THE BENEFITS OF AMD'S TECH.

You may recall that a while back AMD had a 'Windmill' demo to illustrate how the original FreeSync worked to mitigate stuttering and tearing, and now there's a second demo about to be unleashed to show off the benefits of the firm's improved FreeSync 2 HDR technology. The new 'Oasis' demo (note that it isn't a benchmarking utility) has been built using Unreal Engine 4, supports HDR10, and runs through various intricate landscape scenes to make the benefits of FreeSync 2 HDR clear. It will be possible to control the speed of panning, rewind the demo, or change various graphics settings (effects, shadows, bloom and so forth). On top of the titular HDR support, monitors with the new version of Freesync are also guaranteed to feature LFC (Low Frame-rate Compensation), which artificially raises the frame-rate when unable to meet the minimum requirement for FreeSync. It does this by displaying the same frame twice or more in order to meet the minimum and remove tearing and stuttering.

BILLION

BiPAC 8700 Dual-band Series

Our telecommunication capability can grow your business in entirely new ways.

VDSL2/ADSL2+

2.4Gz&5Gz dual-band

Auto Failover & Fallback

QoS

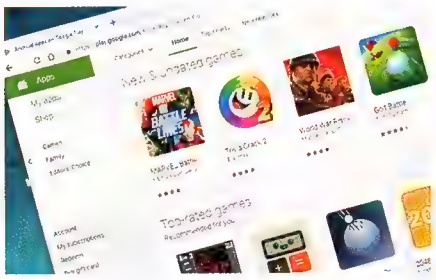
Firewall

- Compliant with VDSL2/ADSL2+ Standard
- Triple WAN for 3G/4GLTE, VDSL2/ADSL2+, and EWAN for broadband connectivity
- Auto Failover and Fallback
- Simultaneous dual-band wireless 802.11ac 1300Mbps (5GHz) and 802.11n 300Mbps (2.4GHz) support
- 5 Giga Ethernet ports included, port #5 can be configured as Ethernet WAN
- QoS and firewall supported
- 2 FXS ports for SIP VoIP call (option)
- VPN tunnels for IPSec, OpenVPN, GRE, L2TP, and PPTP connections (option)

First International Trading Pty Ltd.

First International Trading Pty Ltd
Unit 35, 7-9 Percy Street Auburn NSW 2144
Phone: (02) 8318 3777
Email:sales@billion.com.au / sales@firstint.com.au

au.billion.com



Google blocked a million apps from the Play Store in 2018 due to security issues

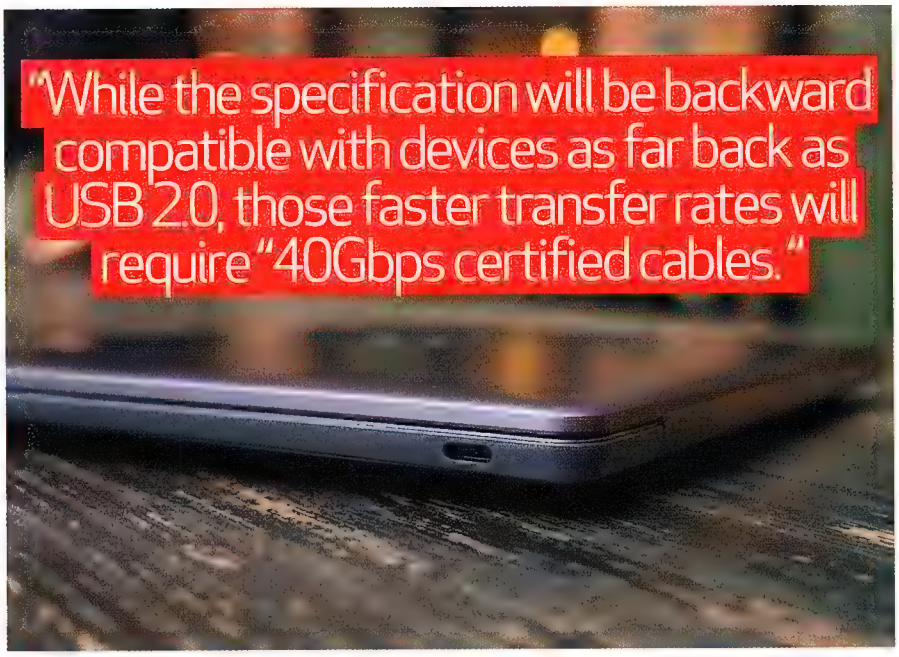
IS WORKING WITH DEVELOPERS TO PREVENT APPS GOING LIVE WITH SECURITY ISSUES.

Protecting its users' security is high on the priority list for Google and the company recently revealed that it has prevented over a million Android apps with security issues from going live on the Play Store in 2018. In a post on the *Google Security Blog*, the company also pointed out that its Application Security Improvement Program has helped over 300,000 app developers fix problems with their software before going live.

Reddit considers letting users tip each other with real money

WHAT COULD GO WRONG?

Reddit, the so-called 'front page of the internet', is trialing a new feature to let users tip each other with real-world money. The feature is only available in a single subreddit at the time of writing, for the Reddit-famous user 'shittymorph', so it remains to be seen whether tipping will roll out more widely across the site.



USB4 catches up to Thunderbolt 3 with 40Gbps data transfer speeds

INTEL'S PROPRIETARY DATA TRANSFER TECH OPENS UP.

Soon, the incredible speeds of Thunderbolt 3 ports in laptops and computers will be available to all future USB Type-C (USB-C) ports, thanks to the brand-new USB4 standard. Hot on the heels of announcing the USB 3.2 Gen 2x2 specification – which itself is yet to become available – the USB Implementers Forum (USB-IF) revealed that the tech behind Intel's proprietary Thunderbolt 3 port will be made available to generic USB-C ports. This means 40 Gigabits per second (Gbps) data transfer rates and multiple 4K display support.

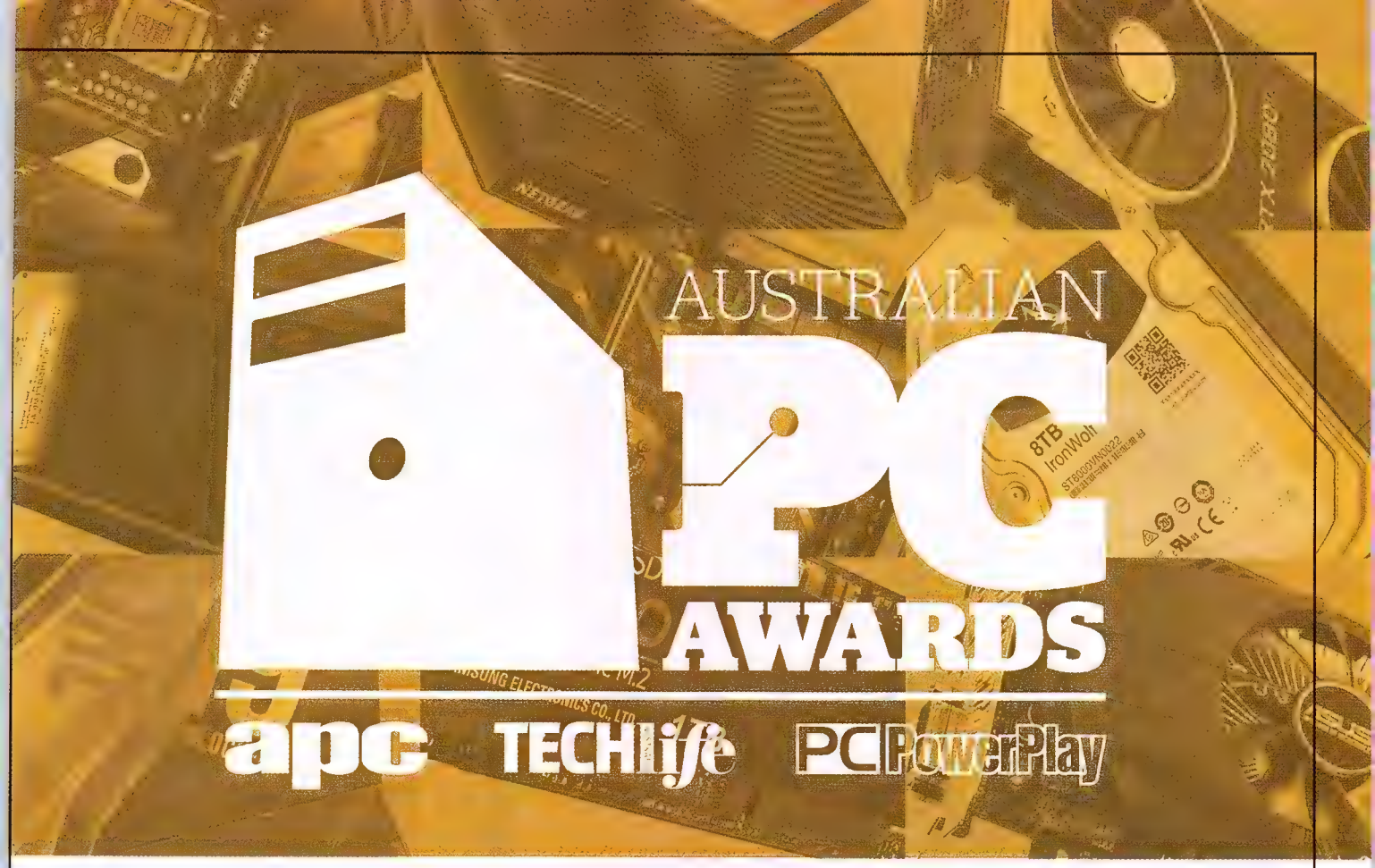
While the draft of the new specification is due to be published mid-2019, it's unclear how long it will take after publishing to see laptops and other computers sporting USB4 Type-C ports. This move is a long time coming, as Intel has intended on making its technology available free of license since 2017. Until now, Thunderbolt 3 was only available on the most premium laptops and computers, as device makers had to work with Intel directly to source the technology. However, this expansion of Thunderbolt 3 into USB4 won't be as hugely democratising as it sounds – at least at first. While the specification will be backward compatible with devices as far back as USB 2.0 (using adapters, of course), those faster transfer rates will require "40Gbps certified cables."

ACCC reckons Aussies have great broadband connections, despite what we think

MOBILE SERVICES ARE DOING WELL TOO, APPARENTLY.

The latest annual *Communications Market Report* from the ACCC has been released and, despite what we've been hearing about much of the nation's telecommunications infrastructure, the report shows a largely positive result for Australians. Overall, the pricing of fixed broadband, mobile services, and mobile broadband have all decreased since last year, with the latter two dropping by close to 10%. Despite the price drop, mobile phone and mobile broadband plans have seen enormous data increases – as much as 172% in the case of the average phone plan – since last year. This is perhaps both in response to, and the cause of Australians using 29% more data than last year in downloads. As for the NBN, activated premises rose from 2.4 million to 4 million, while a similar amount of customers left Telstra's legacy copper network.

While the ACCC fears the NBN will eventually be made redundant by high-speed mobile data (such as 5G), fixed-line downloads currently make up a whopping 91% of Aussie data use, compared to just 6% mobile and 3% wireless usage.



WHAT WON?

Did the gear you voted for in the *Australian PC Awards* get the gong? See the full list of winners as voted for by the readers of *PC PowerPlay, APC, TechLife* and *TechRadar*.

www.australianpcawards.com.au

It's the ultimate list of the very best in PC and games gear.

PROUDLY SPONSORED BY

acer AOC ASUS CORSAIR QNAP

RAZER SAMSUNG Synology thermaltake tp-link

numbercrunch

» WE LOOK AT THE NUMBERS DRIVING THE BIG TECH NEWS.

US $7,000

ESTIMATED COST OF KOHLER'S NUMI 2.0 INTELLIGENT TOILET, WHICH COMES WITH A HEATED SEAT, 'PERSONAL DRYER', BUILT-IN SURROUND SOUND AND GAMING PC-STYLE RGB LIGHTING. IT ALSO HAS GOOGLE ASSISTANT, ALEXA AND SIRI INTEGRATION. MIND-BOG-LING.

1 BILLION

NUMBER OF DEVICES THAT WILL SOON INCLUDE GOOGLE ASSISTANT — that's 500 million more than in April 2018 and 900 million more than Alexa, which is found on just 100 million devices according to Amazon's own stats.

50,000

NUMBER OF TIMES LG'S NEW 'ROLLABLE' SIGNATURE SERIES R9 TV CAN BE FURLED/UNFURLED BEFORE IT BREAKS.

Based around a flexible 65-inch OLED screen, the TV magically appears from its base every time you switch it on, then retracts back into it when it's turned off.

10NM

TRANSISTOR DENSITY OF INTEL'S NEW ICE LAKE PROCESSORS, FINALLY UNVEILED AT CES 2019 AFTER A THREE-YEAR WAIT.

Ice Lake is based on Intel's new Sunny Cove architecture, with the first chips expected to appear in laptops and desktops towards the end of the year.

4TB

STORAGE CAPACITY OF SANDISK'S PROTOTYPE USB FLASH DRIVE UNVEILED AT CES 2019.

No further details have been revealed about the drive, apart from the fact that it comes with a USB-C cable to connect it to your PC.

MID-2020S

POSSIBLE LAUNCH DATE FOR, YES, THE WORLD'S FIRST FLYING ELECTRIC CAR — THE BELL NEXUS.

The Nexus has six swivellable fans that enable it to take off vertically and is likely to first go into service as a flying taxi with Uber. We are truly living in the future. ■

techbrief

» SHARMISHTA SARKAR TAKES A DEEPER LOOK WHAT'S TRENDING IN TECH.

The evolution of the folding phone: from flip to fold

In search of more screen real estate.

Mobile phones evolved from initially being large devices to smaller clamshells (or flip phones like the Motorola Razr), shrinking with each passing year. Then, in 2007, Apple launched the first ever iPhone, ushering in the era of the smartphone. Since then consumers have been asking for more and more screen real estate. Turns out even the plus-sized handsets and phablets aren't enough, so phone manufacturers have decided to design a device that has a folding screen, so it's pocketable when necessary and unfolds into a tablet when needed. Enter the Samsung Galaxy Fold and the Huawei Mate X, both hitting shelves this year.

Developing foldable OLED displays

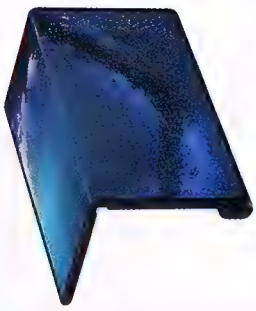
Being flexible wasn't enough.

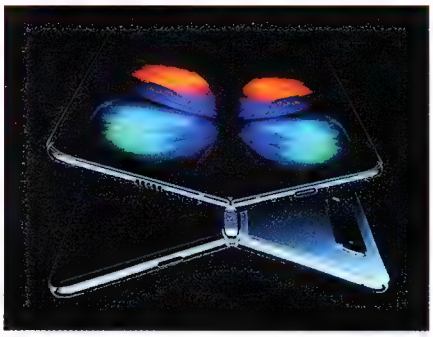
The structural design of glass OLED screens aren't conducive to a folding phone. Instead, plastic made for a more suitable substrate, while also making the device more durable, lighter and thinner. The folding displays also have two other layers made of an organic substance – the conductive layer and an emission layer. This wasn't the only innovation, though – adjacent materials like the optical connective adhesive also needed to change. While Samsung has been mum on how it achieved its goal, experts believe it could have been something called Y-OCTA that embeds touch sensors into the display.

Software changes are catching up to foldable devices

For the seamless transition from pocket to tablet.

To ensure a foldable device provides a seamless experience when transitioning between folding states, the user interface has to undergo changes, and this could be a challenge for developers. Google has already announced that Android support is being expanded for foldable phones. Multi-window displays are already supported, and demos of the Huawei Mate X and the Galaxy Fold show they operate smoothly between folds. However, display rations of 21:9 and 4.2:3 (like in the Galaxy Fold) aren't commonplace, so creating apps for these aspect ratios may pose a challenge.





The best foldable phones coming in 2019

The future of the smartphone has arrived.

Samsung made it very clear that the Fold is a premium device featuring a 4.6-inch HD+ Super AMOLED display on the front, while the unfolded screen is a 7.3-inch QXGA+ (QHD+) Dynamic AMOLED Infinity Flex display. There's a fingerprint scanner on the side, while a 4,380mAh battery, 12GB of RAM, a 7nm processor and 512GB of storage provide the grunt under the hood. It's a rather chunky handset when folded, while the Huawei Mate X looks a lot sleeker.

The Mate X has a solid-feeling hinge that can transform the device from a 6.6-inch phone to an 8-inch Android tablet. The FullView bezel-reduced screen makes it look better than the Galaxy Fold. In terms of specs, it supports 5G, has a new Kirin 980 chipset and a 4,500mAh battery. It runs a customised version of Android and will hit shelves in select markets towards the middle of this year.

While other companies like Xiaomi and LG are also working on folding phones of their own, the most exciting reveal would be what many hope is the remake of the Motorola Razr. However, we'll have to wait a while for more details on that.

How many times can you fold and unfold before you rethink the cost?

Please don't break...

How often do you reckon you'll be folding and unfolding a Samsung Galaxy Fold or Huawei Mate X before you, or the device, reaches breaking point? According to Samsung, the Galaxy Fold can take at least 200,000 transitions which, if you fold it 100 times a day, works out to a lifespan of over five years. Huawei, on the other hand, hasn't revealed how often you can fold the device before something goes wrong. The Mate X has a price tag of €2,299 (around AU$4,000 including GST), while the Galaxy Fold is set to cost about $3,200 in Australia. ■

gadgets

» GOOD GEAR

MICROSOFT SURFACE HEADPHONES

Microsoft has its head-phones in the game.

$499.95 | WWW.MICROSOFT.COM

The Surface Headphones are the first real audio device we've seen from Microsoft, but this doesn't mean they're just slick skull-candy that colour coordinates with your Surface PC. Of course, this is exactly what they are – but they've also been designed to compete with the market leading active noise cancelling headphones from Sony and Bose. 40mm Free Edge drivers nestle inside spacious over ear cups to provide great quality audio with a generous soundscape. The 30 dB of ANC seems to have a good quality ambient noise cancelling algorithm that'll compete with the best around and the on-ear physical dials are a nice bonus feature.

SAMSUNG GALAXY WATCH ACTIVE

A full featured smartwatch on a diet.

US$200 | WWW.SAMSUNG.COM/GLOBAL/GALAXY/GALAXY-WATCH-ACTIVE/

Samsung made the bold move of ditching the rotating bezel on its new Samsung Galaxy Watch Active, but it's also dropped the price by close to 40% in the US without losing too many other features. The 40mm Watch Active has the same processors and memory as its predecessors but is more compact and close to half the weight of the smaller 42mm Galaxy Watch. This form-over-function design decision does mean it has to concede to a 15% smaller 230mAh battery compared to the Galaxy Watch, but Corning Gorilla Glass, 5ATM waterproofing and IP68 water resistance specifications, means it'll withstand any workout you put to it.

HUAWEI MATE 20 RS

A premium leather-bound smartphone.

$2,599 | CONSUMER.HUAWEI.COM/AU/

The price of top-tier smartphones have been creeping up over the past few years, but the $2,599 cost of Huawei's new Mate 20 RS is a decent bump from even the most premium devices currently available. For this you get a 6.39-inch phone with 5G compatibility, a QHD OLED display, one of Huawei's own Kirin 980 processors with advanced AI processing, a Leica-built tri-rear-camera array with a combined 68MP sensor count, a 4200mAh battery, 8GB of RAM and 256GB storage space (expandable via microSD Card). If those specs didn't get you over the line then the device also has 'artisan leather flanks' developed by the Porsche Design team.

SAMSUNG GALAXY FOLD

Unfolding a new Galaxy.

$TBA | WWW.SAMSUNG.COM/AU/

Dubbed the Dynamic AMOLED Infinity Flex display, Samsung's foldable 7.3-inch smartphone display has finally arrived on a device that can be purchased by consumers. While we actually prefer the design of Huawei's foldable Mate X, which bends the screen around the outside for a nicer half-size profile, the Galaxy Fold looks awesome when in tablet mode and it does at least have a second 4.6-inch Super AMOLED screen that can be used when folded. The 16/12/12MP rear camera arrangement won't be winning awards anytime soon, but there's plenty of power in the octa-core processor and 12GB of RAM behind the Galaxy Fold's big screen.

BLUE ELLA PLANAR HEADPHONES

Amp on board.

$899 WWW.BLUEDESIGNS.COM

If $100 isn't quite enough money for you to drop on a pair of headphones, then here's a neat way to spend nearly ten times that. Not just any regular pair of cans, however, these Ella headphones from Blue feature both an on-board amplifier and planar drivers to bring all that audiophile fuss into a somewhat-portable unit. Complete with a futuristic headband that pivots at multiple points and makes you look ready to lead a space mission, these headphones are the perfect tool for listening to live bootlegs from the 70s via low-bitrate YouTube clips.

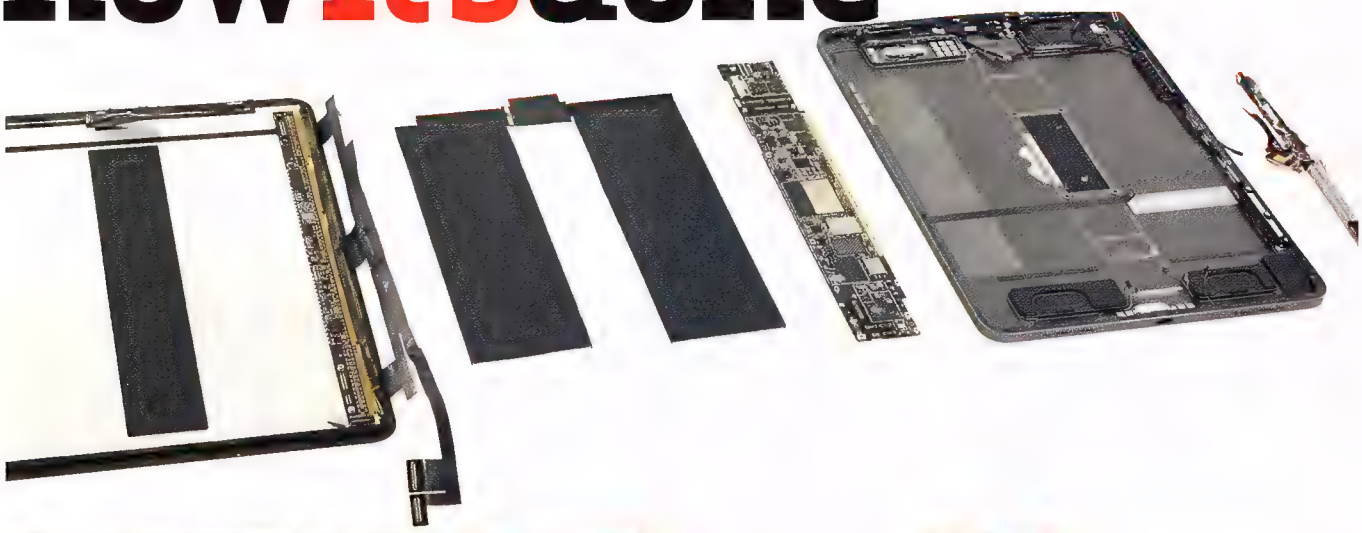
CYGNETT CHARGEUP SWIFT WIRELESS POWERBANK

Who needs cables?

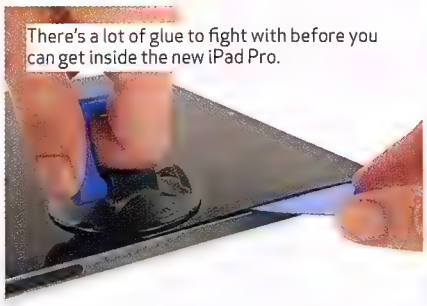
$89 WWW.CYGNETT.COM

There you are, charging up your laptop or tablet via this 10,000mAh power bank, but – what is this? Your phone needs juicing up, too, and you don't have a spare cable, or your power brick doesn't have an extra port, or you're just too damn lazy to plug the thing in. What to do? Just plonk your Qi-compatible phone on top of the Cygnett ChargeUp Swift10K Wireless Power Bank, and voila. Pretty nifty idea. We testing it simultaneously charging in this way and the wireless aspect was as good as any dedicated Qi charger. The price is great value – competitive with stand-alone Qi-chargers – so there's some tasty versatility on offer with this thanks to the included battery pack. ■

howit'sdone



Making its debut in the new iPad Pro is Face ID, as seen previously in the iPhone X.



There's a lot of glue to fight with before you can get inside the new iPad Pro.

The logic board is hidden under this cover and a whole lot more glue.

Apple iPad Pro 11-inch

The glue box.

The new 11-inch iPad Pro sports narrower bezels, curvy LCD corners, and cutting-edge silicon. This is, apparently, the iPad Apple dreamed about building from the beginning, but what we dream about is a device that's easy to repair...

MAJOR TECH SPECS

- Fully laminated, 11-inch, LED-backlit, Oxide TFT Liquid Retina display, with 2,388x1,668 resolution (264 ppi)
- Octa-core Apple A12X Bionic CPU, with M12 motion coprocessor, and integrated seven-core GPU
- 12MP rear camera with 4K video recording at 60fps, and 7MP TrueDepth camera with 1080p video
- Self-balancing, four-speaker audio, Face ID, five microphones, ambient light sensor, accelerometer, barometer, and 3-axis gyro
- 802.11a/b/g/n/ac dual-band MIMO Wi-Fi and Bluetooth 5.0
- 4GB, 256GB, 512GB, or 1TB of on-board storage

KEY FINDINGS

- Final notes before we dive in: No headphone jack, USB-C port (non-Thunderbolt) in place of Lightning, and a long dark oval to charge the new Pencil.
- We loved cutting through all the glue to open our first iPad, and it has never gotten old (sarcasm alert – Ed). These extra-thin bezels make it even more harrowing. Heat, carve, hold your breath, and hope nothing breaks. On the plus side, the display's ribbon cables are a safe distance from the bezels — but they're also spread out in a way that makes display removal really awkward.
- Those cables aren't safe yet, as we're forced to lay the display at a weird angle and hopefully not damage anything while we disconnect them. We put our Phillips driver to work releasing both cable connectors. One thing that immediately stands out is the device's four woofers and four tweeters, for a total of eight speakers.
- Anxious for our first glimpse of that A12X chip, we peel away the logic board cover. Yuck — as always, the board is secured with adhesive, made even fussier by the speakers. But we're soon victorious. The logic board triumphantly emerges from the canyon between the battery cells.
- We're not fans of last year's iPads, which skipped out on the stretch-release battery tabs. This year, pull tabs are back in style. Unfortunately, a huge patch of supergoop runs all the way down the left side. Sigh. Time to break out the pry tools. This iPad's powered by a 7,812mAh battery running at 3.77V, for 29.45Wh — a lot smaller than the latest Microsoft Surface Pro's 45Wh battery.
- Next to come out is the Pencil charging board, with its copper charging coils attached, but tiny capacitors and other board bits go flying in protest as we remove the shields. Last to come out is the USB-C port which, unlike previous iPads, is fully modular. As a high-wear part, the ability to replace it independently is a nice repair win.
- Repairability score: 3 out of 10 (10 is easiest to repair). The lack of a physical Home button eliminates a failure point. The battery is secured with easier-to-remove tabs and non-removable adhesive. The LCD and front panel glass are fused together — simplifying opening, but increasing the cost of repair. Gobs of adhesive hold most everything in place, making all repairs more difficult. ■

» SHAUN PRESCOTT DIGS INTO THE BIG TECH ISSUES.

YouTube will never be safe for children

Efforts to tweak algorithmic curation will never smite abusers, writes Shaun Prescott.

In 2019, most parents with their finger on the pulse will already be aware of the dangers of letting children consume so-called "kid friendly" material on YouTube. But the point was driven home further in February when reports emerged of a pattern of predators leaving timestamps in the comments of videos depicting young children. These timestamps highlighted moments in videos where children are depicted in compromising or inadvertently suggestive positions. Revealed by YouTuber Matt Watson, the report proliferated fast and lead to many companies – including *Fortnite* studio Epic Games – removing all pre-roll ads from YouTube.

To make matters worse, barely a week later reports emerged of kids' videos having suicide instructions spliced into them. In one instance, a Let's Play for the Nintendo Switch game *Splatoon 2* had a brief clip from comedian Filthy Frank edited into it, during which he advises how to most effectively slit one's wrist (in the context of the original video, it's grimly amusing. When spliced into a kid's video, it's utterly disturbing).

These are just two examples, and don't include the utterly bizarre phenomenon of keyword-exploiting, seemingly algorithmically generated CG kids videos that horrified parents last year. In response to February's news, YouTube announced it would automatically close comments on all videos featuring children, but it doesn't seem to fix the problem at its root: that is, a behemoth platform like YouTube can hardly hope to filter its content using algorithms alone.

No doubt YouTube (and obviously, by extension Google's) wield algorithms that are dizzyingly complex and advanced, but time and time again they're either proven ineffective, or people find a way to exploit them.

Still, even if you've got no kids, YouTube can quickly morph from a place you watch game trailers into a breeding ground for extremity. As an anecdotal example: several months ago I was curious about the chemtrails conspiracy (basically, it posits that powerful forces are controlling the population via the dumping of invisible chemicals from the sky). After watching a short video about the phenomenon, I was recommended all manner of conspiratorial material, ranging goofy through to alarming.

There's no point advocating for the deletion of conspiracy videos: that would be silly. But young, impressionable minds can easily be lead astray by an algorithm that, once it detects you've interests of a certain persuasion, it will keep ladling it into your head. YouTube acknowledged the danger of this in January with the announcement that it will re-configure its recommendation feature to prevent conspiracy videos and other "fake news" content. But again, no algorithm will prove failsafe: those determined to espouse hate, or to exploit children, will always find a way on a platform monitored by machines.

The only wise thing to do – now and probably forever, since human-led curation will never conquer the scale of YouTube – is to keep children away from the platform, whether regular YouTube or YouTube Kids. It's probably not safe for adults, either, but that's a different story. ■

END USER

Share your stories!

If you have an interesting story about technology users, their experiences and the issues that affect us all (whether funny or serious), email us at **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include writer's full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

epinions

GOOD TIMES

I started reading *APC* in about 1990, and used to read it from cover to cover. At a certain point the content (from my point of view) slipped, with far to much emphasis on games (of which I have no interest) and nowhere near enough on the PC. I nearly didn't renew my subscription to this year! Then came along the merger of *APC* and *PC & Tech Authority*.

I have just finished reading the January Issue no 463 and I have to say that it is probably the best PC magazine I have read in many years. I read far more pages in this issue than I have done for a long time.

A quick flick through issue 464 also looks like lots of interesting things to read about. So, please keep up the good work.

Bernie

SSD VS. HDD

I'm just reading your SSD article in the February issue and would like to put the following forward. In the 25 years I've been building, buying and using PCs, I've had maybe five hard drive failures. Fortunately, being mechanical devices, it's been a breeze to regain all my data.

I put an SSD in my present machine but began to reckon that once it failed, and fail it surely must, there'll be no recovery of data. Backups happened occasionally. My backups are now daily and to multiple HDDs. The SSD holds the programmes but HDDs are the way to go and are definitely here to stay.

Tony

Ben Mansill replies: *Thanks for your thoughts Tony.. SSD reliability is excellent and you should have no concerns. Having no moving parts actually makes them more durable, and they can withstand extreme temperatures better than an HDD. Recovery of lost data is generally similar for SSD and HDD.*

OFFICE ON A CHROMEBOOK

Just read your editor's intro in *APC*. Do you think the fact that Microsoft is moving to a Chrome-based browser and also that they are pushing more and more to cloud based Office 365 that the Chromebook will just as easily be able to handle MS Office as Google Apps? That would make it much more attractive.

I was thinking of the cloud-based apps that Office 365 has together with OneDrive based on Microsoft's emphasis on cloud delivery with Azure and the direction they are heading. I'm assuming you could run those on a Chromebook via the browser.

James

Ben Mansill replies: *Hi James. Office is supported on Chromebook and by all accounts works perfectly well. Microsoft's published a short but useful guide at* **tinyurl.com/APC466-Chrome**. *It also includes direct links for installing individual Office apps, or just go to the Google Play Store. You can of course save any work to Google Drive, and Microsoft's OneDrive also works very well on a Chromebook.* ■

APCMAG@FUTURENET.COM

Come on, have your say!

We want to hear what you think. Add to these discussions or email your views (in fewer than 250 words) to **apcmag@futurenet.com**. All correspondence becomes the property of *APC* and is subject to editing. Letters must include full name, street address, suburb, state and phone number to be considered for print publication. Address and phone details will not be published.

twobits

» CHRIS SZEWCZYK TAKES A CLOSER LOOK AT THE PC INDUSTRY, AND HOW IT AFFECTS YOU.

Did Nvidia misjudge its Turing pricing strategy?

Chris Szewczyk looks at the state of the new GPU market.

Hello and welcome to my new Two Bits column. Each month I'll take a look at something from the world of PC tech, whether it's a juicy piece of news, a rumour or analysis of a burning tech topic. Let's begin with a look at the state of Nvidia's RTX series of graphics cards and what it means for gamers, as well as Nvidia going forward.

At the launch of the RTX series at Gamescom in August 2018 – if Nvidia CEO Jensen Huang was to be 100% believed – the new Turing GPU brings a graphics revolution. There's no doubt that the industry will increasingly integrate ray tracing into games, though for now game support is limited to minor effects. We're a long way from seeing fully ray traced rendering replace traditional rasterisation entirely.

The raw gaming performance of RTX series cards isn't in dispute, but it's the prices that have left customers with a sour taste in their mouths. This led Nvidia to release a statement to investors in late January explicitly stating "sales of certain high-end GPUs using Nvidia's new Turing architecture were lower than expected... some customers may have delayed their purchase while waiting for lower price points and further demonstrations of RTX technology in actual games." This points to the fact that many gamers just aren't feeling compelled to upgrade from their Pascal cards at this point in time. If you're lucky to be sporting a GTX 1070 or higher, you're looking at a significant dollar outlay to bring you up a tier in performance. It seems Nvidia misjudged its pricing strategy. Perhaps we'll see pricing gradually decline over the coming months in a bid to spur sales.

There are examples all across the range, but let's look at the RTX 2070 vs the GTX 1080. The 2070 costs more than a GTX 1080 did, and while it's faster, it's not overwhelmingly so. RTX features aside, customers just don't want to shell out $750+ for a card that's not significantly faster than one they've had for over two years.

So why is that pricing so high? Turing is complicated architecture. The addition of dedicated ray tracing and Tensor cores, which the previous Pascal generation did not feature, means that Turing dies are much larger relative to their predecessors, even taking into account their smaller production nodes. The end result is higher prices, but surely that's not the only reason? Is the industry still suffering from a mining hangover? The crypto mining boom saw Nvidia and AMD drowning in cash as all available video cards were snapped up by miners. Both manufacturers just couldn't make enough cards to satisfy demand. This led to massively inflated prices well above their RRPs. Did Nvidia misjudge and assume customers would be prepared to pay that much more at each respective tier? $2,000+ for the top card is a price level that was unimaginable just a couple of generations ago.

Competition is what the gaming GPU space desperately needs. As you can read elsewhere in this issue, the sudden appearance of AMD's Radeon VII failed to deliver a significant blow. Let's hope AMD's upcoming Navi GPUs bring some welcome competition back into the market. AMD needs a Ryzen effect for its GPUs. If that happens, Nvidia will be forced to reconsider its high pricing model. ■

> "The raw gaming performance of RTX series cards isn't in dispute, but it's the prices that have left customers with a sour taste in their mouths."

High refresh vs. High Dynamic Range vs. High resolution

The *APC* team seeks out the best kind of high.

The modern monitor market is marvelous: 240Hz refresh, resolutions of 4K and beyond, and latterly eye-popping HDR capabilities. But all three in a single monitor? That's an awfully big ask. And it's an awfully big ask because upping the refresh and resolution, or adding HDR (high dynamic range) capabilities, all increase the required bandwidth. You simply can't have the highest available resolution, the fastest refresh, and HDR all in one monitor. Something's gotta give. But what should that be? It all depends on your chosen remit.

Round 1

GAMES

Pumping more pixels has always been a problem when it comes to gaming. Higher resolutions put more strain on your graphics subsystem. And that means lower frame rates. When nearly all monitors ran at 60Hz, however, that often didn't matter. If a higher resolution dropped your frame rate from 120fps to 70fps, you wouldn't actually be able to see the difference on a 60Hz panel.

But now that screens with refresh rates up to 240Hz are available, it's a whole different ball game. Even today, the graphics card that can drive all the latest games at well beyond 100Hz at 4K doesn't exist. So, if you want super-slick and responsive gaming, you want a high-refresh panel with a middling pixel count. Something like 1440p, in other words, rather than 4K.

As for HDR, game support is limited. But where it is available, HDR can look fantastic. So, if you're looking for a long-term solution, an HDR panel is certainly appealing. A true HDR panel will, of course, guarantee strong performance in terms of contrast and colour depth. That's a plus for SDR or standard dynamic range games, not just titles that support HDR.

WINNER:
Refresh rate plus a little HDR

Round 2

PRODUCTIVITY

It's surprising how sweet high refresh rates are even for the simplest of day-to-day computing activities. Everything feels more responsive, immediate, and natural at higher refresh rates.

Despite that, we wouldn't prioritise high refresh over resolution for productivity. More often than not, more pixels are of greater value for getting stuff done. For starters, you can see more, which is not only more practical and ergonomic, in the sense that you can see more of a given webpage, or view multiple pages and documents at the same time, but also critical when it comes to the likes of editing images and video at full resolution. For that, there's no substitute for more pixels. Of course, high resolution at any screen size also results in a tighter pixel pitch. That means a sharper image, crisper fonts, and all that jazz.

If more pixels are nice, what about HDR? It's not an obvious win for productivity, especially as most HDR monitors do horrible things to SDR content when running in HDR mode. On the other hand, a monitor capable of one of the more demanding HDR standards will have an inherently high-performing panel.

WINNER:
Resolution

Round 3

MOVIES AND VIDEO

You could argue that 4K content is thin on the ground, as the majority of what you might call legacy content isn't available in 4K, but pretty much all major new movies are now released at that resolution. Likewise, streaming services such as Netflix and Amazon are making more and more 4K content.

You could say the same of HDR, but more so. Only a subset of 4K content is available in HDR. However, a screen with HDR support is more capable, thanks to greater contrast and colour performance. That makes SDR content look better, too. A screen with higher resolution than the source content doesn't help at all. Indeed, interpolating a low-res image on a higher resolution panel typically delivers a worse result than rendering the same image at native resolution.

As for high refresh rates, they're irrelevant to nearly all video content. Few movies are captured in anything even approaching high frame rates. So-called High Frame Rate, or HFR, movies – like *The Hobbit* – are just 48fps. Streaming content recorded at 60fps is becoming more common, but either way, a standard 60Hz monitor has a sufficiently high refresh rate.

WINNER:
Resolution and HDR

Round 4

VALUE

For reasons that elude us, high refresh monitors remain very pricey. We suspect that being perceived as a gaming-centric feature encourages screen makers to price their high refresh models up in the stratosphere. That's poor value for anything but a dedicated gaming panel.

On the other hand, 4K monitors are now genuinely affordable. We're not just talking about 4K screens with the cheapest of TN panels. In the last year, the number of 4K models with VA and IPS panels for around $400 has increased dramatically. A 32-inch 4K monitor with a good quality panel from a decent brand for $450? Now that is an appealing value proposition. Other than serious gamers, anyone on a limited budget will get much more overall bang for their buck going for more pixels than higher refresh rates.

HDR is trickier. Much depends on how you define HDR. True HDR displays with local dimming or, even worse in terms of cost, an OLED panel, remain very expensive. Pseudo HDR monitors with wider colour spaces, though, aren't necessarily much more expensive, but they aren't necessarily much better than a conventional SDR display.

WINNER:
Resolution

Round 5

VIRTUAL REALITY

OK, VR feels pretty dead, what with the Oculus Rift 2 being cancelled, and the founder of Oculus VR, Palmer Luckey, recently implying that people didn't want VR even if it's free.

But it's still an intriguing technology, and one we can't entirely dismiss. But of refresh, resolution, and HDR, which is the most important for virtual reality displays? The short answer is all of 'em. But some are more important than others. The most important is refresh rate. You need at least 90Hz to have a solution that feels reasonably responsive. Without that, the experience is sluggish, unconvincing and, for many, even nausea-inducing.

Resolution matters, too. With the display filling your field of view, you need a lot of pixels to avoid the screen door effect – in fact, more than any commercial VR headset offers. As for HDR, that too would be a requirement for a truly convincing VR world. It isn't quite as important for enabling a good basic experience, though, and it's probably the least problematic in terms of implementation in a VR context. So, odds are, by the time the res and refresh barriers are hurdled, HDR will be an easy add-on.

WINNER:
Refresh then resolution

And the winner is...

Taking your pick between resolution, refresh rates, and HDR support is all about remit. Heavy gamers will put a major premium on higher refresh rates, even though they come at a cost. For anyone else, resolution should be their priority in most cases. It gives you more screen real estate, nicer fonts, sharper images, and the ability to see larger images and video files in all their glory.

Money no object? Why not go for both? Simple, because there's no such thing as a 5K monitor with 120Hz-plus refresh rate. Even 4K monitors with triple-digit refresh have only very recently become available at a painful price.

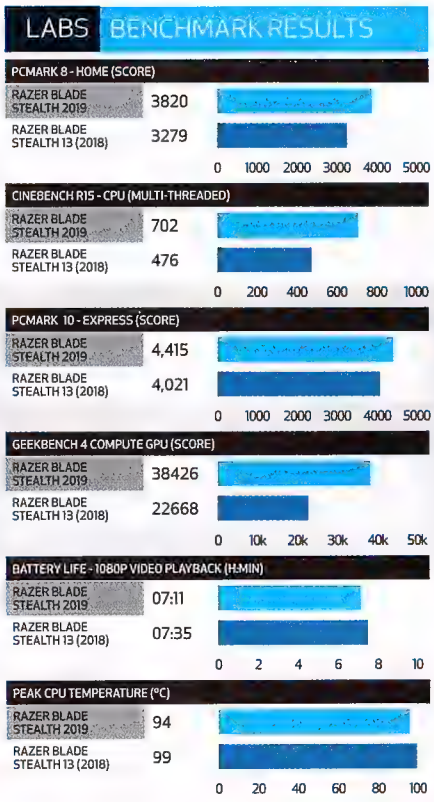
HDR is more complicated. That's partly because of the wide range of HDR standards, some of which deliver on the premise much more effectively than others. It's also because of patchy content availability and problematic implementation in the Windows OS.

Having all three would be nice, but if there can be only one, more pixels deliver more all-around utility more often than the alternatives. ■

apc HOT PRODUCT

GAMING LAPTOP

FROM $2,449 | WWW2.RAZER.COM/EN-AU/



Razer Blade Stealth (2019)

The Blade Stealth has a new CPU/GPU combo, but is this enough to make it a proper gaming ultrabook?

Razer has always offered some of the best looking laptops money can buy, and the 2019 black-anodised aluminium Razer Blade Stealth is no exception. Returning to the 13-inch form factor, we're continually surprised by how small modern ultrabooks can be. Sliding in at a 1.48cm thickness, the new Stealth earns its Razer name, and the 30.5 x 21cm footprint and 1.28kg weight mean this device is just about as portable as a laptop can be.

Despite being so compact the Blade Stealth manages to maintain a nicely weighted keyboard that has a decent travel distance for an ultraportable. This keyboard is skirted by a pair of subtle speaker grills that combine with an additional two undercarriage speakers to create Dolby Atmos three dimensional sound, which isn't bad for personal cinematic playback.

Razer seems to be paring back the number of premium options on this year's Blade Stealth, offering just the one FullHD display option locally and a maximum of 256GB of storage space. You do still have a choice to make: whether you'd prefer the base model with 8GB of RAM, a 256GB SATA 3 SSD and an Intel UHD Graphics 620 GPU for $2,449; or if you're willing to pay a few hundred more for 16GB of RAM, a much faster 256GB PCIe M.2 SSD and an Nvidia GeForce MX150 GPU.

Those upgrades are well worth the additional cost in our eyes, not just because the additional RAM is great for work efficiency (you can have way more browser tabs open at once), but also because that GPU isn't too bad. The Nvidia GeForce MX150 is between 40% and 50% less powerful than a GTX 1050 GPU in 3DMark benchmarks, so we're hesitant to call it a fully-fledged gaming GPU. That said it does offer three times the performance of the stock Intel UHD Graphics 620, allowing you to play games like *Ghost Recon: Wildlands* or *Middle Earth: Shadow of War* at playable 30fps averages if you drop the quality settings right down or run them in 720p. Less demanding titles like *Overwatch*, *Rocket League*, or *Fortnite* will run really well on this system, so if you only ever game lightly then this is an awesome option.

The Blade Stealth also has an updated Intel Core i7-8556U CPU. This Whisky Lake chip was announced back in August 2018 and while it still uses a 14nm die, it's had a number of considerable optimisations that make it more efficient. It can also boost to a frequency of 4.6GHz for extreme responsiveness in short demanding tasks. This affords the new Razer Blade Stealth a 50% boost in results on demanding CPU tasks like HWBot's 1080p media encoding benchmark from the 2018 Blade Stealth with 16GB of RAM. The performance boost isn't as dramatic in longer and more diverse work tasks, but we still saw a 5-20% uptick in general work benchmarks — which is more than what you generally get from new generation CPU upgrades.

The 53Wh Li-Ion battery will last about 4 hours and 20 minutes using performance mode to complete demanding tasks.

The Razer Blade Stealth is a considerable upgrade from last year's model in terms of CPU and GPU performance. Unfortunately you will have to live with just 256GB of storage space, but other than this there isn't many ways you can fault the Blade Stealth 2019. ■ **Joel Burgess**

Verdict

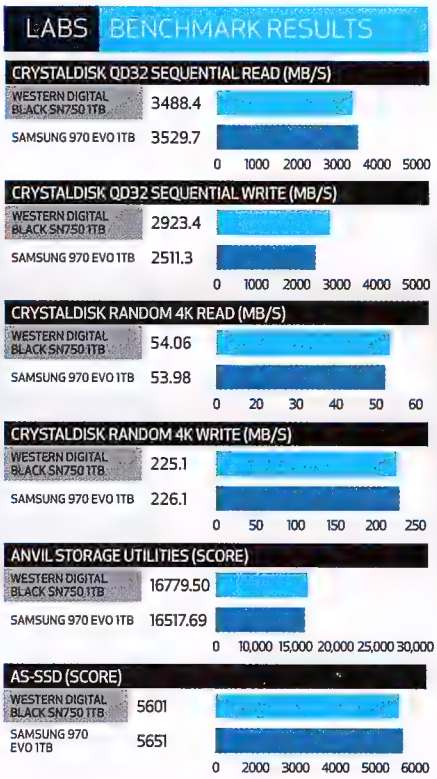
A real beauty to behold with performance to match.

★★★★½

apc HOT PRODUCT

NVME M.2 SSD

$279 | WWW.WESTERNDIGITAL.COM



Western Digital Black SN750 1TB NVMe SSD

WD brings a strong contender.

Western Digital's Black series of NVMe SSDs have impressed us in the past, though perhaps they lacked that final edge that put them ahead of the likes of the class-leading Samsung 960 and 970. Fast forward to today, and we have the latest iteration of WD's Black NVMe SSD, the SN750. It hopefully irons out a couple of the quirks found in earlier generation models. Western Digital is now fully integrated with SanDisk, meaning WD SSDs are now completely designed and built in-house. This means WD joins a small club along with Samsung that has this capability. Can WD now go head to head with the Korean king?

The WD Black 1TB is a standard 80mm M.2 2280 NVMe drive that makes use of a PCIe 3.0 x4 interface. It uses SanDisk BiCS (Bit Cost Scaling) 64-layer 3D TLC NAND flash memory – the same NAND found in the preceding WD Black. We might have expected to find cutting-edge 96 layer NAND, though perhaps we'll see that in a WD Blue or Green drive at a later date, where affordable capacity is needed more than outright performance. WD also plans to offer SN750 drives with an optional (and fantastic looking) EK designed heatsink.

WD's using its in house designed and built 20-82-007011 controller here, which supports common functions such S.M.A.R.T. monitoring, but like the previous Black, there's no support for disk encryption if that is something that's important for you. The drive comes with a 600 TB Written endurance rating and a 5 year warranty, matching most of the others in this class.

WD offers its Dashboard SSD software package that enables users to update the firmware, see S.M.A.R.T. reports, monitoring and performance statistics. New to this generation is the addition of 'Gaming Mode'. This stops the drive from entering a low-power state, meaning you'll get peak performance at all times, – although this will increase power consumption a tad, something to particularly note for laptop users.

As an evolutionary upgrade, we didn't expect the new SN750 model to blow away the older model, but it does definitely offer improved performance. We're just about at the limits of the PCIe 3.0 x4 interface, so there aren't going to be any leaps in sequential read and write performance until PCIe 4.0 drives hit the market. Sequential reads and writes are very competitive compared to its tough competitor, the Samsung 970 Evo.

It's hard to believe that only eight or nine months ago, the 1TB WD Black was priced at over $600! Now we have an improved version that's less than half the price. 1TB class drives are cheaper than ever, and WD's SN750 offers top shelf performance to match. With a quoted $279 price for the 1TB model, it's simultaneously one of the cheapest and best performing drives on the market. Will the competition be forced to lower prices? WD has hit its stride. With price/performance like this, it's become a very serious player in the SSD market.

■ **Chris Szewczyk**

Verdict

Western Digital brings its A game. The SN750 Black 1TB is a top performing NVMe SSD at a fantastic price.

★★★★★

GRAPHICS CARD

$1,169 | WWW.AMD.COM

AMD Radeon VII

AMD surprises with a high-end weapon.

Ever since the launch of Nvidia's RTX series, AMD has been a non-factor in the high-end GPU market. That changed when AMD CEO Dr Lisa Su took to the stage at CES in Las Vegas earlier this year and proudly showed off the simply named Radeon VII. It's been some time since AMD made an attack on the high end and with the Radeon VII, AMD finally has a weapon to fight with.

We were somewhat surprised by the Radeon VII announcement. While AMD's Ryzen CPU range has been well received by both the PC market, not to mention Wall Street, GPU enthusiasts waiting for something to shake up the market in a similar way have been left waiting. AMD's Navi architecture is on track for later in 2019, perhaps AMD's GPUs will see their 'Ryzen moment'.

Back to the aptly named Radeon VII. It's the world's first 7nm GPU. At a high level, it's a die shrink of the current 14nm Vega GPU that powers the Radeon Vega 64 and Vega 56 cards. Vega is an interesting architecture. It performs well in games that support its unique feature set, but Vega's heat and power consumption levels have always been a concern compared to their Nvidia competition. On paper a die shrink should deliver reduced power consumption and thermals, though, as we'll see, AMD has used the additional power budget to push the architecture to its limits in an attempt to extract maximum performance, all else be damned.

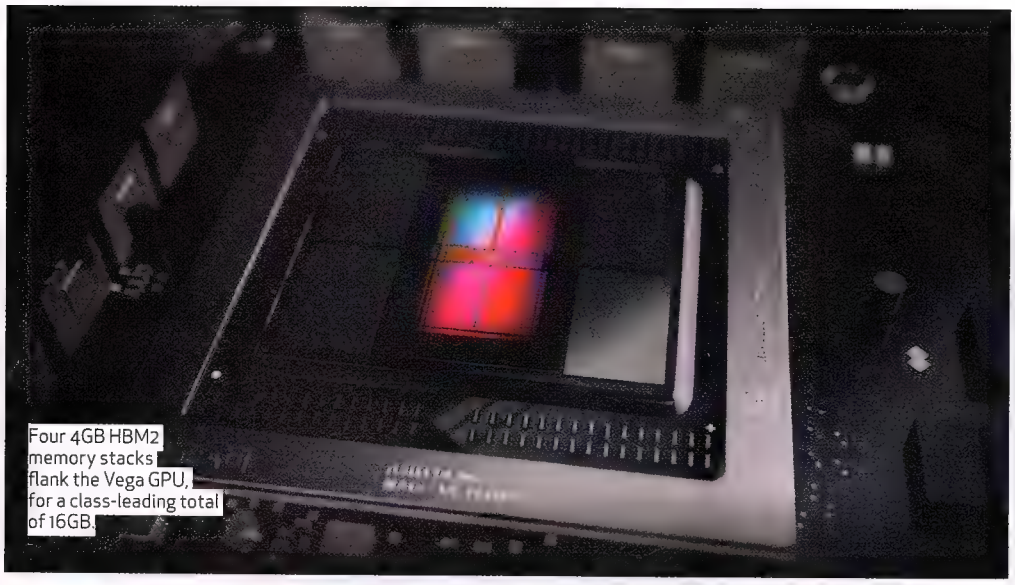
VEGA REFINED

AMD states it has made a few tweaks with regards to reducing latency as well as tweaks aimed at increasing clock speeds. 7nm Vega is interestingly not the full GPU with its 3840 Stream processors vs the Vega 64's 4096. It's likely that that the full GPU is reserved for a professional card.

At 331 sq mm, the 7nm Vega 20 die is much smaller than the 495 sq mm Vega 10 powering the Vega 64. This allowed AMD to add additional HBM2 stacks to the package for a total of 16GB! This is perhaps the most impressive feature of the Radeon VII. It gives the card an effective memory bus width of 4096 bits. It's true that games require an ever increasing amount of VRAM. Modern games at

AMD RADEON VII BENCHMARK RESULTS

	GHOST RECON WILDLANDS (VERY HIGH PRESET AVG FPS)			TOTAL WAR: WARHAMMER II (HIGH PRESET AVG FPS)			SHADOW OF WAR (ULTRA PRESET AVG FPS)			SHADOW OF THE TOMB RAIDER (AVG FPS)		
	1920X1080	2560X1440	3840X2160	1920X1080	2560X1440	3840X2160	1920X1080	2560X1440	3840X2160	1920X1080	2560X1440	3840X2160
NVIDIA GEFORCE GTX 1080 TI	112.3	87.7	53.3	139.1	96.8	51.6	123	87	51	113	78	42
NVIDIA GEFORCE GTX 1080	94.8	72.4	42.4	102.1	71.4	39.0	98	67	39	92	62	33
AMD RADEON VEGA 56	75.1	57.0	33.9	85.8	55.7	28.1	85	57	35	81	55	29
NVIDIA GEFORCE RTX 2070	102.3	79.2	45.3	123.6	84.9	44.8	114	80	48	104	71	37
NVIDIA GEFORCE RTX 2080	119.0	91.0	54.0	152.0	104.0	55.0	134	96	58	127	88	47
AMD RADEON VII	102.1	81.9	51.5	126.8	85.1	43.3	124	88	54	121	83	45



Four 4GB HBM2 memory stacks flank the Vega GPU, for a class-leading total of 16GB.

"The higher clock frequencies and insane memory bandwidth place the Radeon VII generally in between the RTX 2070 and RTX 2080."

4K resolution with high levels of AA and things like high-res texture packs all chew up memory, so much so that even 8GB can be limiting in some cases. If 16GB isn't enough for your game, then no other current card will be sufficient.

So, we've got a 7nm GPU with 16GB of HBM2 over a 4096 bit bus that delivers 1TB/s of memory bandwidth. AMD has certainly made a technological statement. Unfortunately these impressive specifications tell only part of the story. The Radeon VII carries a 300W total board power rating, which is up 5W from the Vega 64. It's clear that AMD went for the brute force approach in an attempt to extract maximum performance. When you compare this to the roughly equally priced Nvidia RTX 2080 with its 215W TDP, it starts to look a bit ugly. Straight up, if noise levels, thermal performance and power consumption are important to you, the Radeon VII has a significant handicap.

MEET THE RADEON VII

The Radeon VII certainly looks like a premium graphics card. Gone is the inadequate blower style cooler that's been used on recent AMD reference cards. In its place, AMD has included a large triple axial fan cooler that should be more capable of handling the high thermal load inherent to Vega cards. The reference Vega 56 and 64 cards were amongst the loudest GPUs we've ever tested under full load. AMD has equipped the Radeon VII with the latest display outputs. There's a single HDMI 2.0b port alongside three DP 1.4 ports.

Given the Radeon VII is heavily based upon the existing Vega architecture, we didn't expect any revolution in performance. The higher clock frequencies and insane memory bandwidth place the Radeon VII generally in between the RTX 2070 and RTX 2080. While a competent performer. Its performance per watt leaves a lot to be desired. A card pulling 300W under a typical load isn't ideal.

Gaming isn't the only use for a card like this though. AMD strongly believes the the Radeon VII is a competent prosumer content creation card. With its 16GB of memory it should perform well in professional tasks that have been coded to take advantage of the Vega architecture. If you've been happy with Vega, you'll be happy with the Radeon VII.

Does the new cooler make a difference when compared to the sometimes downright noisy Vega reference cards? We're sad to say that it hasn't. The Radeon VII cooler ramps up very quickly. It's one of the loudest cards we've ever tested. It has to do this, though, given that we saw temperatures reaching into the upper 70s very quickly. Boost clocks stay reasonably consistent but we never saw the peak 1800MHz that AMD claims is possible. Perhaps with quality watercooling this might be possible.

AMD has made a technological statement with the Radeon VII. It's a 7nm GPU, and got 16GB of insanely fast HBM2 memory. If AMD could fix some of the inefficiencies in the Vega architecture, this could have been the gaming top dog. Alas, it's not to be. The GeForce RTX 2080 is a better buy at this point in time. We'd like to see a lower price, which has to be difficult for AMD given the likely very high bill of materials and complexity of the card. AMD is offering a quality three game bundle at the time of writing which does add value to the card.

If you're an AMD fan, the Radeon VII is a fast card, but you'll have to put up with a lot of noise and hefty power consumption. It's a fantastic technological statement from AMD, but we can't recommend it over the RTX 2080 at this price.

■ **Chris Szewczyk**

AMD RADEON VII BENCHMARK RESULTS

	TEMPERATURES DEGREES ◎		3DMARK		GEEKBENCH GPU COMPUTE
	IDLE	LOAD	TIME SPY	FSE	SCORE
NVIDIA GEFORCE GTX 1080 TI	37	79	9406	13015	215977
NVIDIA GEFORCE GTX 1080	38	74	7790	10157	191741
AMD RADEON VEGA 56	36	79	6356	8462	201770
NVIDIA GEFORCE RTX 2070	36	72	9067	10678	267539
NVIDIA GEFORCE RTX 2080	37	72	10844	12731	300663
AMD RADEON VII	39	78	8914	12252	233124

Verdict

A surprise high end offering, but its specifications are hampered by ageing Vega weaknesses.

GRAPHICS CARD

$509 | AU.MSI.COM

MSI GeForce GTX 1660 Ti Gaming X 6G

Is this the card to take the sweet spot gaming crown?

The Turing-based Nvidia RTX 2000-series cards released to date perform well and have a very forward looking set of features. One thing they aren't known for, though, is great value. Mainstream gamers – the ones buying cards in the $200-$400 range – have been patiently waiting for Nvidia to release something that caters to them. The cheapest card in the RTX range, the RTX 2060, still starts at around $600, a price that's too far outside of the range of mainstream gamers. Does a typical gamer playing *Fortnite* or *Overwatch* or MOBA titles need ray tracing capability? The large die GPUs found in the RTX 2060 and up are simply not economical to sell at prices to cater to the mainstream market.

Enter the GeForce GTX 1660 Ti. It omits all of the die space hogging RTX features and aims to shake up the mid-range market with its focus on delivering a quality core gameplay experience in today's games.

The GTX 1660 Ti is powered by the TU116 GPU. It is equipped with 1536 CUDA Cores and 24 SM units. 6GB of 12 Gbps GDDR6 memory connects over a 192-bit bus to deliver 288 GB/s of bandwidth. The base clock speed is set at 1500MHz. The official boost clock speed is 1770MHz, though as is often the case with Nvidia's GPU Boost algorithm, most cards, including the MSI GTX 1660 Ti we are reviewing, are capable of boosting much higher than their official boost clocks when thermal and power conditions allow it. Of particular note is the low TDP of just 120W. Nvidia really deserve credit for producing a GPU that significantly outperforms the

MSI GEFORCE GTX 1660 TI GAMING X 6G BENCHMARK RESULTS

	GHOST RECON WILDLANDS (VERY HIGH PRESET AVG FPS)		TOTAL WAR: WARHAMMER II (HIGH PRESET AVG FPS)		SHADOW OF WAR (ULTRA PRESET AVG FPS)		SHADOW OF THE TOMB RAIDER (AVG FPS)	
	1920X1080	2560X1440	1920X1080	2560X1440	1920X1080	2560X1440	1920X1080	2560X1440
NVIDIA GEFORCE GTX 1080	94.8	72.4	102.1	71.4	98	67	92	62
NVIDIA GEFORCE GTX 1070	80.5	59.6	92.3	60.1	80	54	74	49
AMD RADEON RX 590	64.7	48.1	66.8	42.7	82	54	66	44
AMD RADEON VEGA 56	75.1	57.0	85.8	55.7	85	57	81	55
NVIDIA GEFORCE RTX 2070	102.3	79.2	123.6	84.9	114	80	104	71
NVIDIA GEFORCE RTX 2060	91.4	67.6	103.8	70.1	95	66	88	58
MSI GEFORCE GTX 1660 TI GAMING X	82.3	60.8	89.8	60.2	82	56	80	53
NVIDIA GTX 1060	60.7	44.1	65.7	43.0	56	38	54	35

GTX 1060 it ostensibly replaces, while keeping the TDP at the same level.

The Turing TU116 GPU delivers many upgrades over its Pascal predecessor. The SM units (streaming multiprocessors) have been revamped. A Turing SM is now capable of concurrent floating point and integer execution whereas Pascal FP units would idle while an INT instruction was executed. The cache subsystem has also been overhauled. The L1 and texture caches are now unified, allowing sharing of resources. According to Nvidia, games coded to take advantage of the features and improvements that Turing offers can deliver up to a 50% performance improvement compared to the GTX 1060 within the same power envelope. In anyone's book, that's a hell of a generational improvement.

Whether the GTX 1660 Ti is a true replacement for the 1060 is open for debate. It all comes down to price. The 1660 Ti gets a significant upwards bump in price over the outgoing 1060. The MSI Gaming X we are reviewing carries a price of $509. MSI and other manufacturers will have cheaper models, but it's hard to call a $500 card mid-range. We'll see how the market reacts, but the fear remains that Nvidia has priced the card $50-$100 too high for it to be named the undisputed mid-range king. There remains a big gap in the $250 to $400 price range that's crying out for a new champion.

As there isn't a Founders Edition card for this launch, we have received MSI's GTX 1660 Ti Gaming X 6G for our review. It's a custom design card featuring MSI's highly regarded Twin Frozr cooler. With its factory overclock, machined back plate and RGB implementation. It's every bit a premium offering, sitting atop MSI's GTX 1660 Ti product stack. The MSI maintains the same base and memory clocks of the base GTX 1660 Ti specification, however the boost clock is substantially higher at 1875MHz, an impressive 105MHz improvement.

The TU116 GPU isn't a demanding one so there isn't a need for complicated PCBs and many phase PWM designs. The MSI Gaming X PCB leaves space for further memory chips and chokes, indicating MSI could use this PCB for a more powerful variant. Perhaps we'll see GTX 1670 Ti or similar in the future? MSI has chosen not to include the USB Type-C VirtualLink. You do get three DP 1.4 ports and a HDMI 2.0b port.

The 1660Ti stacks up well in the price/performance stakes.

The card definitely looks like a premium offering. MSI has ditched its traditional red accents in favour of a neutral grey colour scheme. This prevents any clashing with the RGB lighting, and it looks great without being over the top.

MSI is calling this latest generation cooler the Twin Frozr 7. It introduces new fans that improve static pressure along with unusually waved heatsink fins that MSI claims are more efficient. The fans are disabled while the card is under 60°C for silent idle operation. Under gaming load, we saw a temperature peak of just 63°C with the fan at auto. This meant our sample was able to sit at a stable 1950MHz, and not drop at all! Excellent!

So, to the all-important question. How does it perform? Very well! It absolutely destroys the GTX 1060 and generally gets its nose ahead of the GTX 1070. It also all but makes AMD's RX 590 and Vega 56 cards obsolete, at least without significant price cuts.

MSI has produced an excellent GTX 1660 Ti. It's cool, quiet, power thrifty and it's a good choice for a gamer with a high refresh rate 1080p monitor. Whether this premium MSI version of the 1660-Ti is worth it to you is between you and your finances. It's got great build quality and it looks fantastic. You're also likely to get consistently high boost clocks compared to a lesser model.

The GTX 1660 Ti is an excellent graphics card. Our only reservation is its pricing. If you're upgrading from a card that's several years old, you'll be very happy, but if you have something like a GTX 1070 that amazingly went for a similar price a couple of years back, well, you made an excellent purchase. ■

Chris Szewczyk

> "It omits all of the die space hogging RTX features and aims to shake up the mid-range market with its focus on delivering a quality core gameplay experience in today's games."

MSI GEFORCE GTX 1660 TI GAMING X 6G BENCHMARK RESULTS

	TEMPERATURES ©		3DMARK		GEEKBENCH GPU COMPUTE
	IDLE	LOAD	TIME SPY	FSE	SCORE
NVIDIA GEFORCE GTX 1080	38	74	7790	10157	191741
NVIDIA GEFORCE GTX 1070	37	73	6266	8218	163882
AMD RADEON RX 590	38	84	5180	6783	150386
AMD RADEON VEGA 56	36	79	6356	8462	201770
NVIDIA GEFORCE RTX 2070	36	72	9067	10678	267539
NVIDIA GEFORCE RTX 2060	36	71	7694	8820	222767
MSI GEFORCE GTX 1660 TI GAMING X	34	63	6840	7450	191416
NVIDIA GTX 1060	33	68	4512	5985	129675

Verdict

MSI's GTX 1660 Ti is an excellent card, but all GTX 1660 Ti's are priced a fraction too high at this point in time.

★★★★☆

apc HOT PRODUCT

INTEL Z390 MOTHERBOARD

$679 | WWW.ASUS.COM/AU

Asus ROG Maximus XI Apex

One for the overclockers.

Asus' Maximus Apex series motherboards have quickly built a reputation for superb overclocking. While all Republic of Gamers (ROG) boards are highly capable overclockers, it's the Apex series that takes things to the next level. Asus usually takes its time with Apex development. Z390 motherboards have been available for some time, and despite being teased for many months it's only now that the Maximus XI Apex is making its debut.

This is a board built from the ground up for overclocking. It's got a best-in-class power delivery system with chunky heatsinks to keep it cool. Despite being an ATX board, Asus consciously equips the Apex with only two memory slots for an optimal electrical design with minimal interference.

As you'd expect with a pricey motherboard, it comes with good set of features including the unique DIMM.2 M.2 SSD solution, plenty of USB 3.1 ports and AC MU-MIMO Wi-Fi. The XI Apex comes with Intel I219-V LAN. Sadly the Aquantia 5G LAN that came with the previous Maximus X Apex is absent. Of course, there's an attractive dose of RGB lighting and all the overclocking features that serious overclockers and LN2 junkies could ever really need.

Overclocking with air or water cooling is a walk in the park for the Maximus XI Apex. This is a board that cries out to be pushed hard. It was able to push our i9-9900K to 5GHz before CPU temps started to become seriously concerning with a 2 x 120mm AIO watercooler. With anything short of subzero cooling, your CPU will run out of thermal headroom well before the board breaks a sweat. If you're a serious overclocker, either for 24/7 use or competitively, you'll likely be aware of the headroom for high performance that Apex motherboards are capable of.

It likewise does a superb job with high speed memory. We used a set of G.Skill Trident DDR4-3733 that uses the overclockers' favourite Samsung B-Die IC's. If your CPU has a capable memory controller, then you simply won't find a board with better memory capabilities and BIOS support. Our test CPU seems to struggle with very high speeds, though DDR4-4000 with tight 12-12-12 timings was easily doable. It's the best DDR4 memory overclocking motherboard we've come across to date. You can even pair it with 32GB double capacity modules for a total of 64GB in a dual slot board.

The Maximus XI Apex's BIOS has pretty much every conceivable feature you could ever need. It can be a bit daunting for novice users but once you're used to it, its chock full of things to tweak. There are also profiles provided by well known extreme overclockers that provide a good starting point, particularly with regards to commonly used RAM and its sub-timings.

If you're looking for a motherboard that can extract the most from your RAM, and push a demanding CPU like the i9-9900K to its limits on air, water or liquid nitrogen cooling, then you simply won't find a better motherboard.

Some other boards have some extra features, but if overclocking is your focus, this is the board for you.

■ Chris Szewczyk

Verdict

Performance junkies looking to extract the maximum from an Intel system won't find a better option.

★★★★★

apc HOT PRODUCT

"Acer claims the hood is there so you can focus on your game. Like a horse on a racetrack wearing blinkers."

MONITOR

$1,999 | ACER.COM.AU

Acer Predator XB273 Monitor

144Hz refresh rate, at 4K, with an IPS panel? No, it's not a dream!

Acer's had a good run with their Predator monitors, releasing some truly excellent gaming displays to the market like the X34 and X34P. The 27-inch XB273KP is Acer's latest addition to the Predator range. It boasts UHD 4K, IPS, DisplayHDR 400 certification, Nvidia G-Sync and a 144Hz refresh rate, making it truly worthy of the Predator branding.

Let's start this review by looking at the exterior of the XB273KP, because it comes with a rather unique feature not normally seen on gaming monitors – a hood. If you've hanged around professional photographers or graphic designers, you might have noticed a plastic frame around their displays to keep stray sources of light away and maintain colour accuracy. But on the XB273KP, Acer claims the hood is there so you can focus on your game. Like a horse on a racetrack wearing blinkers, I guess? Luckily, the hood is removable.

The included stand is solid and allows for a good range of adjustments to suit your preferred ergonomics. The stand is kitted out with LEDs that can project a cool user configurable glow onto your desk and there's even a little latch on the back of the stand that when pulled down, is a spot to store your headphones. If you need more adjustment than the stand provides, there's a VESA mount in the box you can use to attach the XB273KP to any stand that suits your needs.

As soon as the XB273KP is powered up, a small fan turns on to keep the monitor's internals cool. It makes sense a fan would kick in at 120Hz or 144Hz as the display processing hardware is working hard, but at a regular 60Hz for desktop use, the fan can be annoying in a quiet room. In an ideal world Acer would have configured the fan to only run at high temperatures.

Putting aside the XB273KP's quirks, it's a damn fine monitor. Thanks to the IPS panel, colour accuracy is well above most traditional gaming monitors with TN or VA-type panels, providing 90% coverage of the DCI-P3 colour gamut. IPS panels are normally shunned by gamers as there's a trade-off between colour accuracy and high refresh rates, but Acer's pulled a rabbit out of its hat and provided the best of both worlds – high colour accuracy and high refresh rates of 120Hz and 144Hz with Nvidia G-Sync support to keep everything smooth as butter. Even more amazing is that the XB237KP does all this at 3840 x 2160!

The catch for all this amazing performance is price. The XB273KP retails for $1,999. That's a lot of coin for a monitor and unfortunately out of the price range of most gamers. That said, if you can afford a rig that can actually achieve 120fps or 144fps at 3840 x 2160, maybe $2,000 for a monitor is no big deal. Not buying the XB273KP to go with your dual RTX 2080 Ti GPUs in SLI would be like owning a Ferrari and getting a set of $90 eco tyres. ■ **Anthony Agius**

Verdict

If your PC has the grunt to power along at near-144fps then here's a monitor to take full advantage.

★★★★½

ROUTER

$499 | WWW.TP-LINK.COM/AU/

TP-Link Archer AX6000

Even in these early days, the next generation of Wi-Fi is looking special.

AX Wi-Fi has arrived and it aims to enhance wireless network performance by boosting speed and responsiveness while reducing network congestion. There are many technical improvements but they vary in complexity. We've seen MU-MIMO before but it's been less-than-thrilling as a bolted-on addition to earlier technology: we've higher hopes for it now that it's integrated into the standard. The key improvement is called orthogonal frequency-division multiple access (OFDMA) which supposedly "Increases average throughput by a factor of four in high-density scenarios." In basic, technical terms it ups the number of independently-modulated and simultaneous sub-carriers in a single 20MHz channel from 52 (AC wireless) to 234. There's also band steering to automatically ensure that less-crowded bands are used.

Unfortunately, compatible AX computer adapters won't become available until the second half of the year – only the new Samsung Galaxy S10 smartphones are currently fully compatible. However, performance improvements should extend to older-technology connections too.

First, we performed our regular Wi-Fi range tests using an iPad Pro, Ookla's Speed Test and a 115/5Mbps Telstra cable internet connection. This was done next to the router, one floor up then another floor up while simultaneously playing online PC games and watching YouTube on two old Android tablets. History dictates that performance will drop off the higher we go – even with Mesh systems and Wi-Fi extenders. However, TP-Link's Archer AX6000 achieved maximum speeds at all locations! Could it just have killed the need for Mesh networks?

Our S10+ also achieved maximum internet speeds at all distances but the AX6000 offers theoretical network performance of 4,804 Mbps (5GHz) and 1,148 Mbps (2.4 GHz) so we attempted some 2GB file transfers using our Dell XPS' integrated AC Wi-Fi then again using the S10+ as a tethered, USB Wi-Fi dongle. Using the 2.4GHz band, AC transfer hit 102Mbps while AX hit 319Mbps. On the 5GHz band AC Wi-Fi hit 492Mbps while AX was slower at 341Mbps. These low AX scores merely reflect the foibles of Wi-Fi testing and that an integrated laptop antennae will usually beat a jury-rigged USB/phone connection.

A final note on performance is that AX's complexities require serious processing, which is why there's a 1.8GHz quad-core processor on-board. We certainly noticed the expected boost in responsiveness this affords with many video streams opening almost-instantly.

Elsewhere, the AX6000 looks impressive and we're pleased to see eight Gigabit Ethernet ports. The WAN port supports 2.4Gbps connections to suit office environments. There are two USB 3.0 ports: Type-A and Type-C. Other router features are largely standard though we were impressed by the ease of access to settings – both by browser of TP-Link's app. A major boon are the built-in Trend Micro Security features, which offer antivirus and some decent family filtering options including the ability to set usage limits and bed times for different users across multiple devices. At $499 it's not cheap, but it's got all the important features, looks good and performs so well that you likely won't need to buy other networking equipment for a long time to come. ■ **Nick Ross**

Verdict

A new performance paradigm: TP-Link sets the new standard for Wi-Fi routers.

★★★★★

ROUTER

$569 | WWW.ASUS.COM/AU

Asus RT-AX88U

Packed with features but a bit half-baked. We expect this to improve with time.

Asus' new RT-AX88U is from the alien attack fighter school of router design, so its angular black chassis, four large antennae and gold detailing will look awesome or awful, depending on your personal taste.

The theoretical speeds offered by AX6000 routers are (roughly) 6,000Mbps: 1,148Mbps on the 2.4GHz channel and 4,804Mbps on 5GHz. We'd love to have tested maximum speeds but, unfortunately, AX Wi-Fi adapters won't be available until around Q3 2019. While we had an AX-compatible Samsung Galaxy S10+ phone on hand, this could not beat older AC Wi-Fi speeds using the Asus, even when used as a tethered, USB Wi-Fi dongle. We also tried to transfer files from a directly-attached, fast USB SSD but, try as we might, we could not convince the router to enable transfers. This left us testing performance the old-fashioned way: sharing a 115/5Mbps internet connection with an iPad Pro on each floor of a three-storey town house. While we were testing, two children were watching YouTube videos on old Android tablets while a teenager was shooting things on an online PC on the top floor.

Up close the Asus recorded 86Mbps download speeds. One floor up and this dropped to 73Mbps, while on the top floor it dropped to 46Mbps. This is decent last-gen performance but we expected more. To verify, we tried the S10+'s AX Wi-Fi and saw maximum speed on the ground floor, followed by 107Mbps and 83Mbps as we moved upstairs. This improvement came despite the phone's weaker Wi-Fi antenna which suggests Asus's router is not quite as compatible with our test environment as TP-Link's AX6000 (previous page). To be fair, it's very early days and firmware and driver updates will likely fix a multitude of sins.

Somewhat making up for performance shortfalls is an impressive feature list. However, while we applaud having eight gigabit Ethernet plus two USB 3.1 ports, the old-school, web-browser-based settings eschew a simple, modern layout for a crowded mess.

Nonetheless, we were impressed with the integrated malware and family protection tools that are provided by Trend Micro. Asus calls them AiProtection Pro and TP-Link offers the same thing.

There are many, elaborate QoS settings which allow you to set the priority of different types of apps (gaming, VoIP, streaming etc). In addition to these are more-specific 'Game Boost' QoS integrations including WTFast for maximising MMO game stability and LAN Boost which (also) promises to prioritise game traffic performance. Another 'QoS' feature records all web surfing history, which may spark privacy issues.

Multiple USB settings allow you to configure the USB ports in various ways: web server, 3G/4G dongle, print server, Time Machine, Samba and FTP server. Asus AiCloud options add more web server functionality plus integration to Asus' cloud services. Other features enable VPNs, Alexa plus IFTTT integration with other smart devices.

Some of the extra features will intrigue buyers but it all feels a bit messy and half-baked at the moment. At $569 it's very expensive and with a solid, faster, cheaper TP-Link rival outperforming it, most people would be better off saving money and buying that. ■ **Nick Ross**

Verdict

Loaded with features and potential performance, but it's not quite there yet.

★★★☆☆

DDR4 RAM

$699 | WWW.THERMALTAKE.COM.AU

Thermaltake WaterRam RGB Liquid Cooling Memory 32GB

RAM that demands to be seen.

Thermaltake is one of the biggest proponents of RGB lighting and liquid cooling, so it's no surprise that it's combined both into a niche product. Yes there are RGB memory products and RAM water blocks, but what about both together?

It comes in both 2 x 8GB and 4 x 8GB configurations. Its 16.8M colours and effects can be controlled with TT's RGB Plus software and... wait for it... Amazon Alexa! The motherboard manufacturers' control software can also be used. In use it looks spectacular, and the TT software functions very well. Water cooling integration is easy thanks to widely supported G1/4in connectors.

However, Thermaltake's missed a trick by using Hynix RAM chips instead of the more capable Samsung B die. RAM priced at this end of the market should use the best. While DDR4-3200 16-18-18-38 is not exactly slow, you're not going to get a mega OC out of it. The price is also a concern, although the target market for TTs WaterRAM isn't likely to be swayed by this. Water blocks aren't cheap, so we're not going to be too critical of TT on this point.

Thermaltake has produced a niche product that looks fantastic, and that's its primary purpose. You'll instantly know whether it's for you or not. The rest of us will find cheaper and/or better performing options at this price point. ■ Chris Szewczyk

Verdict

TT WaterRAM is gorgeous, but is obviously only aimed at those going for aesthetics above all else.

★★★½☆

THUNDERBOLT 3 DOCK

$569 | WWW.ELGATO.COM

Elgato Thunderbolt 3 Pro Dock

A well made and handsome dock with what we'd consider a full set of connectivity options.

While pricy at $569, the set of ports here is impressively comprehensive. It connects to your machine via a single Thunderbolt 3 cable, which also allows charging at an impressive 85W. The front of the aluminium case has a pair of USB 3.1 Type-A ports, combo headphone and mic jack and seperate SD and microSD card slots, and around the back there is a headphone jack, Gigabit Ethernet, DisplayPort 1.2, a pair of USB 3.1 Type-C ports, a pair of Thunderbolt 3 ports (thoughtfully labelled distinctly to differentiate them from the USB Type-C ports) – one of which is used to connect to and recharge your laptop – plus the power plug. Both headphone jacks are power amplified, too.

It's winning versatility without compromise. Twin monitors are supported via Thunderbolt 3 and DisplayPort and the maximum resolution is 5,120 x 2,880 via Thunderbolt 3 (or 4,096 x 2,160 if using DisplayPort). This is also the first dock we're aware of that gives you three downstream USB-C ports. In a perfect world, we would have liked one more USB Type-A, to allow a keyboard and mouse to be used while keeping one remaining USB port free for portable drives.

The now Corsair-owned Elgato has delivered a thoughtfully designed dock that manages to include nearly every form of connectivity and powering a laptop owner could ask for. ■ Ben Mansill

Verdict

Generous port choices, good power supply for charging and decent cable length.

★★★★☆

"Setting up is simple via the Deco app: it walked us through setting up the network, setting the password, updating the firmware and adding the second node."

apc HOT PRODUCT

ROUTER

$230 FOR DOUBLE KIT. | WWW.TP-LINK.COM/AU/

TP-Link Deco M4 AC1200 Wi-Fi Mesh

Have we hit peak AC mesh with this late-to-market kit from TP-Link?

While TP-Link is the first to market with the Archer AX6000 AX router (see page 32) it might just be the last to market with its AC1200 M4 Mesh system. It's not even TP-Link's first mesh, so we're intrigued to see what it brings to the table in a mature market where prices from some competitors have tumbled.

Our package included two nodes. We placed one downstairs next to our router and connected it via one of its two Gigabit Ethernet ports. The other we placed one floor up in a bedroom. Setting up is simple via the Deco app: it walked us through setting up the network, setting the password, updating the firmware and adding the second node.

The app is slick, responsive and intuitive to use. Features are plentiful and include a guest network (which you can shake your phone to share) a blacklist for banned devices and IP address reservation. So far so normal. However, it's rare to see IPv6 options on a mesh app but it's here and is joined by VLAN options for compartmentalising traffic. Port forwarding is also available as is TP-Link DDNS which allows you to access local resources on the internet via a friendly domain name. There's also a 802.11r Fast Roaming feature which speeds up switching between nodes. However, this can knock older devices off your network.

Setting QoS priority is a bit of a kerfuffle as you need to manually set the total bandwidth assigned to priority devices. Some may prefer this granularity, though. You can add managers to help manage the network by inviting them through email but it's likely to be the Parental Controls that particularly-interest many potential purchasers. You can set profiles with content filters for child, pre-teen, teen and adult. These make hit-and-miss attempts at blocking nefarious content types or resolutely halt access to specific websites. You can also set hourly time limits and bed times on weekdays and weekends for different devices.

You can switch the LED lights off and turn nodes into access points. There are notifications and reports to inform you about new device connections and firmware. It's also Amazon Alexa and IFTTT smart device compatibility. As such, it's one of the most fully-featured mesh kits we've seen, but how does it perform?

The AC1200 Wi-Fi moniker refers to the maximum theoretical throughput of 867Mbps on the 5GHz band plus 300Mbps on 2.4GHz. TP-Link says it can manage 100 different devices but not at the same time. We tested using our 115/5Mbps Telstra internet connection with an iPad Pro and Ookla's Speed Test. Up close it managed maximum speeds. One floor up it managed 110Mbps. Another floor up, where there was no node, it managed 57Mbps. Impressive stuff.

This is about as good as an AC mesh system gets. The advanced features will attract some but price will be of prime importance to most. At $230 for a double-pack it's the cheapest mesh on the market. If you need one, this is the system to buy. ■ **Nick Ross**

Verdict

Fast, fully featured and cheapest on the market. It's our mesh of choice.

★★★★★

apc HOT PRODUCT

SMARTPHONE

$1,499 | WWW.SAMSUNG.COM/AU/

Samsung Galaxy S10+

Brilliant despite some flaws. But farcically expensive.

In the world of increasingly similar, shiny, glass oblongs that is the smartphone market, the annual launch of the latest Samsung flagship traditionally represents a breath of fresh air – even if it's not always for the right reasons. Has the new S10+ let the side down? Let's see: unnecessarily thin bezel? Check. Bonkers new innovations that don't work properly? Check. Superlative camera performance? Check. Same flaws that haven't been fixed for years? Check. Genuine innovation? Check. Overcrowded interface that's packed with bloatware? Negative.

Samsung is launching four flavours of the S10. The standard version has a 6.1-inch curved screen while the S10+ is 6.4-inches and a second selfie camera. A forthcoming 5G version has a 6.7-inch screen while a new, 'budget' S10e has a flat, 5.8-inch screen.

CLASSY DESIGN

In terms of looks, the black glass box we reviewed still oozes sophistication thanks to a practically absent bezel and subtle, glass curves. The notch at the top of the screen has impressively been replaced by the embedding of two cameras near the top, right-hand corner in a less-intrusive way. When the phone is set to always-on mode, the time and notification display looks classy. More impressive-looking is the fingerprint symbol near the base of the screen which denotes where the in-screen, ultrasonic fingerprint reader resides. Here's where things start reverting to type...

The technology behind the biometric sign-on systems both sounds and looks impressive but it's not very practical. The fingerprint reader is borderline hopeless: setting it up takes ages and it usually locked us out after five, failed attempts. Meanwhile, the face recognition system has a couple of flavours: secure and accurate and fast (but false-positive prone). You can see it working because a cool lighting effect circles the cameras. But it only works about 50% of the time. We mostly used unlock patterns. Having got used to Huawei's rapid, almost-flawless equivalent, we were a bit annoyed.

CLEAN ANDROID

Once in, we were pleased to be greeted with the clean interface of Android 9 – codenamed Pie – rather than the bloated-with-crapware Samsung screens of yore. Pie's primary improvements take time to manifest; revolving around learning your behaviour to increase performance and the usefulness of apps. There are also navigation improvements plus digital wellbeing features to stop you wasting your life looking at screens.

But the unwelcome apps aren't all gone. To the left of the screen there's the Bixby button (which you can't disable). We're assured that this hapless joke of an assistant would be better this time. It isn't. Voice recognition accuracy is still as bad as the Google Assistant's is good.

The screen is superb thanks to its AMOLED technology, 19:9 ultra-wide

format and 1440 x 3040 resolution. These combine to produce incredibly vivid colours against a true-black background. Pictures and movies look great under ordinary circumstances but, by supporting HDR10+ compatible content (such as Amazon Prime), it looks so bright and vibrant that only the best TVs can rival it.

The barely-there curved edges aren't as slippery as predecessors and they're better at not registering every touch. While there were some ghost touches in general operation, they only got annoying when viewing pictures and video as the slightest knock would activate an on-screen overlay. The screen and base are constructed from super-strong Gorilla Glass 6 but we'd still recommend using a protective case (and make it easier to interact with).

Despite the same curved edges as the S9, ghost inputs have been reduced.

SPEED AND POWER

Under the hood there's a Mali 2.73GHz octo-core processor with G76 GPU. Storage and RAM can vary considerably: 128GB models come with 6GB or 8GB RAM, 512GB variants have 8GB while 1TB versions can house up to 12GB. Our base-spec review unit was super-responsive and flew along no matter what apps and games we threw at it.

The S10+ also sports latest-generation 802.11ax Wi-Fi. While we struggled to test the massive speeds that this new standard affords, the improved responsiveness when opening video streams was particularly noticeable.

The speakers are noteworthy in that they get incredibly loud and punchy for a device so thin, especially when Dolby Atmos is activated. Bass response isn't massive but all forms of music and movies sound great. The bundled AKG earbuds are decent quality too; offering good fidelity, reasonable bass performance and a proper audio jack connection.

The S10+ somehow squeezes in a 4100mAh battery. This manages to last a full day no matter how punishing we were with the phone. The usually-slow wireless charging has doubled in speed and it will wirelessly charge WPC Qi-compliant devices (when the battery is above 30%).

> "The stars of the show are the five cameras. Three at the back offer ultra-wide-angle, regular and 2x zoom functions – switching between them is quick and intuitive."

Other features include IP68 waterproofing which allows for 30-minutes submersion at 1.5m. This performed better than predecessors with the almost-hydrophobic nature of the screen allowing for hot tub operation without making the screen go haywire.

CLASS-LEADING CAMERAS

The stars of the show are the five cameras. Three at the back offer ultra-wide-angle, regular and 2x zoom functions – switching between them is quick and intuitive. No matter what we were shooting, the automatic scene selector guessed right... portraits, food, sunsets, greenery, night. Almost everything we shot came out immaculately well-exposed, sharp and extraordinarily colourful. Multiple depth-of-field effects are varied and impressive. It still offers best-in-show low-light ability and only struggled when we took handheld shots of the stars and underwater portraits: extreme situations where it retained sharpness at the expense of noise.

Selfie cameras are more important than ever and the front-mounted duo offered superb performance thanks to great portrait-friendly depth-of-field effects. They can even shoot 4K video.

Meanwhile, primary video was slick, HDR10+ compatible and offered some of the best image stabilisation we've seen. Other notable features include composition helper (which was hit and miss) and a useful palm-recognition, selfie-timer trigger.

The base model is $1,499 while special ceramic versions are $1,849 (512GB) and $2,399 (1TB) which is, frankly, ridiculous. Despite the foibles, it's still the best all-round phone on the market but, my word, you pay for it. ■ **Nick Ross**

Verdict

A brilliant phone with some frivolous flaws and a preposterous price tag.

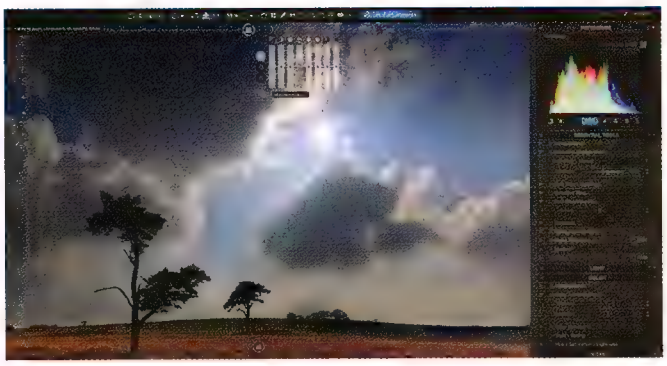
★★★★★

Windows SOFTWARE

DxO Photolab

A heavy duty RAW processing tool form the world's most notorious camera benchmarker.

FROM US$129 | WWW.DXO.COM



DxO PhotoLab has evolved from DxO Optics Pro, a tool designed specifically for maximum quality raw processing and lens corrections, after DxO bought the Nik Collection from Google and added in Nik's control point adjustments. DxO PhotoLab keeps the raw processing and lens correction power that made Optics Pro so effective, but the new local adjustment tools transform it into a powerful photo-editor in its own right, not just a high-end raw converter.

PhotoLab 2 goes a step further, adding a new PhotoLibrary panel for managing and searching your images. This is still in its early stages, though, with more features yet to be added.

In the meantime, you get the same folder browsing tools offered by DxO all along, and the same non-destructive editing workflow. When you select a folder, PhotoLab will scan the EXIF (shooting information) data in the files and automatically apply a correction profile (or prompt you to download one). It's designed primarily for raw files, but it will also apply lens corrections to JPEG images if they're unedited and straight from the camera.

You can also apply manual adjustments, local editing adjustments and preset image effects, and PhotoLab supports 'virtual copies' so that you can try out lots of different adjustments on the same photo without having to create new files.

PhotoLab comes in two editions: Essential and Elite. You need the Elite edition to get DxO's PRIME Deniose and ClearView contrast enhancement, together with camera calibration profiles, custom palettes and a number of other more advanced features.

PhotoLab is pretty technical, and it's aimed more at experts than beginners. You can use it for simple one-click corrections, but getting the best from it demands a bit more expertise.

If you forget about the PhotoLibrary features for a moment, PhotoLab's performance is exceptional. It can extract a level of detail and microcontrast from camera raw files that other programs just can't. However the 'PhotoLibrary' autofill search tool doesn't feel finished yet and PhotoLab already has regular folder browsing, which is fine for many users. **Rod Lawton**

Avid Media Composer Ultimate 2018.12 review

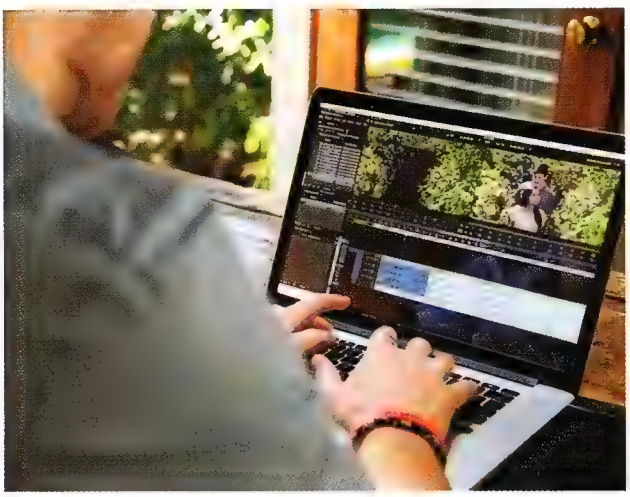
A COMPLEX, POWERFUL AND VERSATILE CROSS-PLATFORM VIDEO EDITING APP.

$500 PER YEAR | WWW.AVID.COM/MEDIA-COMPOSER-ULTIMATE

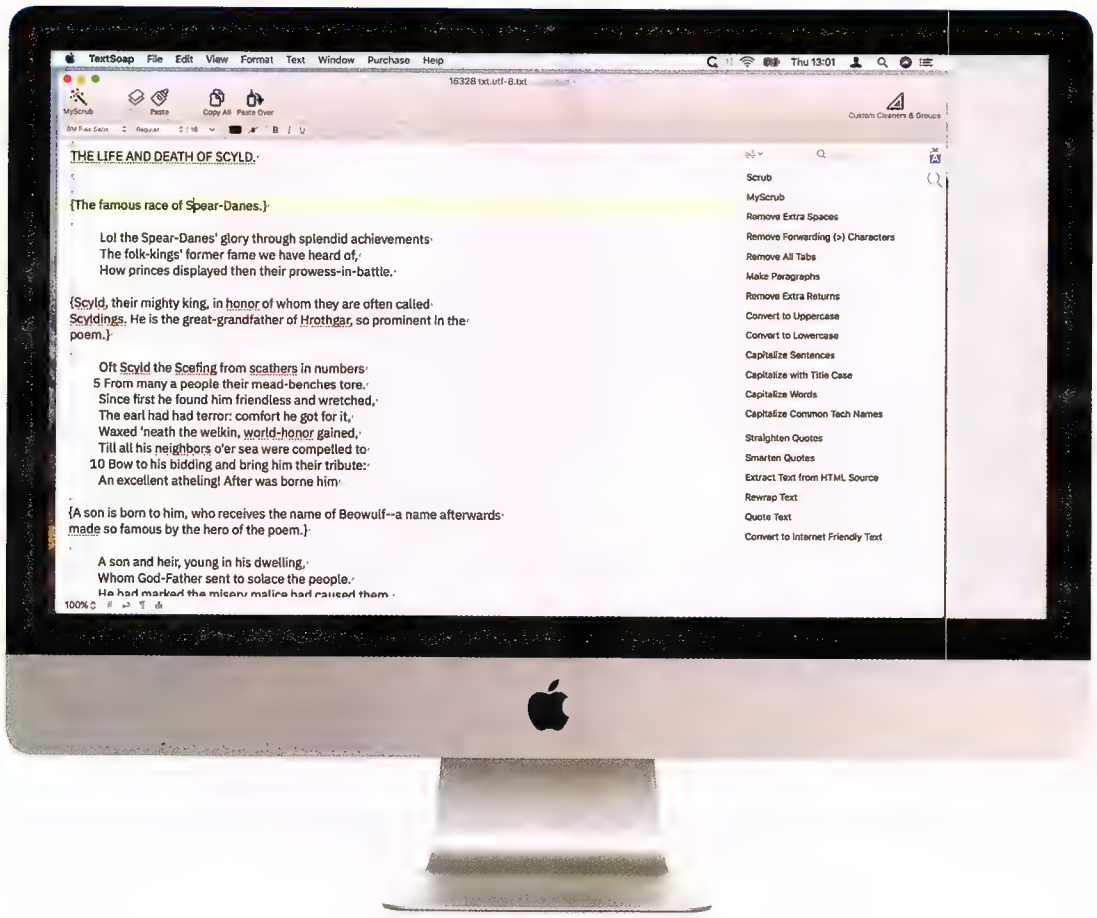
Avid is the granddaddy of video editors. It's been there since the beginning and still commands a lion's share of the professional video editing market. It is the industry standard, and although an increasing number of films are also cut on Adobe Premiere and Final Cut Pro, chances are high that if you're going to be working in a professional environment, this is what you'll be sitting in front of day after day.

Although the interface is immediately recognisable to anyone who's used any other type of video editing software, its customisability will please those who are into creating the work environment that suits them perfectly.

Every part of the interface is a floating window, which can be resized and moved around. If you're planning on becoming a professional editor, this is likely the way to go,



but for those on the fence, the software comes with a 30-day free trial, so you can put it through its paces before you buy it. **Steve Paris** ■



TextSoap 8

Tame unruly text with this powerful clean-up tool.

US$44.99 | UNMARKED.COM | NEEDS OS X 10.10 OR LATER

Text formatting can be incredibly inconsistent – we've all cursed the results after trying to extract something out of an email, for example. If that sounds familiar, TextSoap can help. From simple text to entire manuscripts, it banishes odd capitalisation, dreadful formatting, email quote marks and more.

It's incredibly powerful and fast: analysing and removing all the extra spaces from a 76,000-word manuscript took a fraction of a second on our iMac, and other operations like converting into sentence case or replacing straight quotes with smart quotes was also quick. The sidebar provides easy access to the most commonly used cleaners, which you can apply to anything you select in the main TextSoap window.

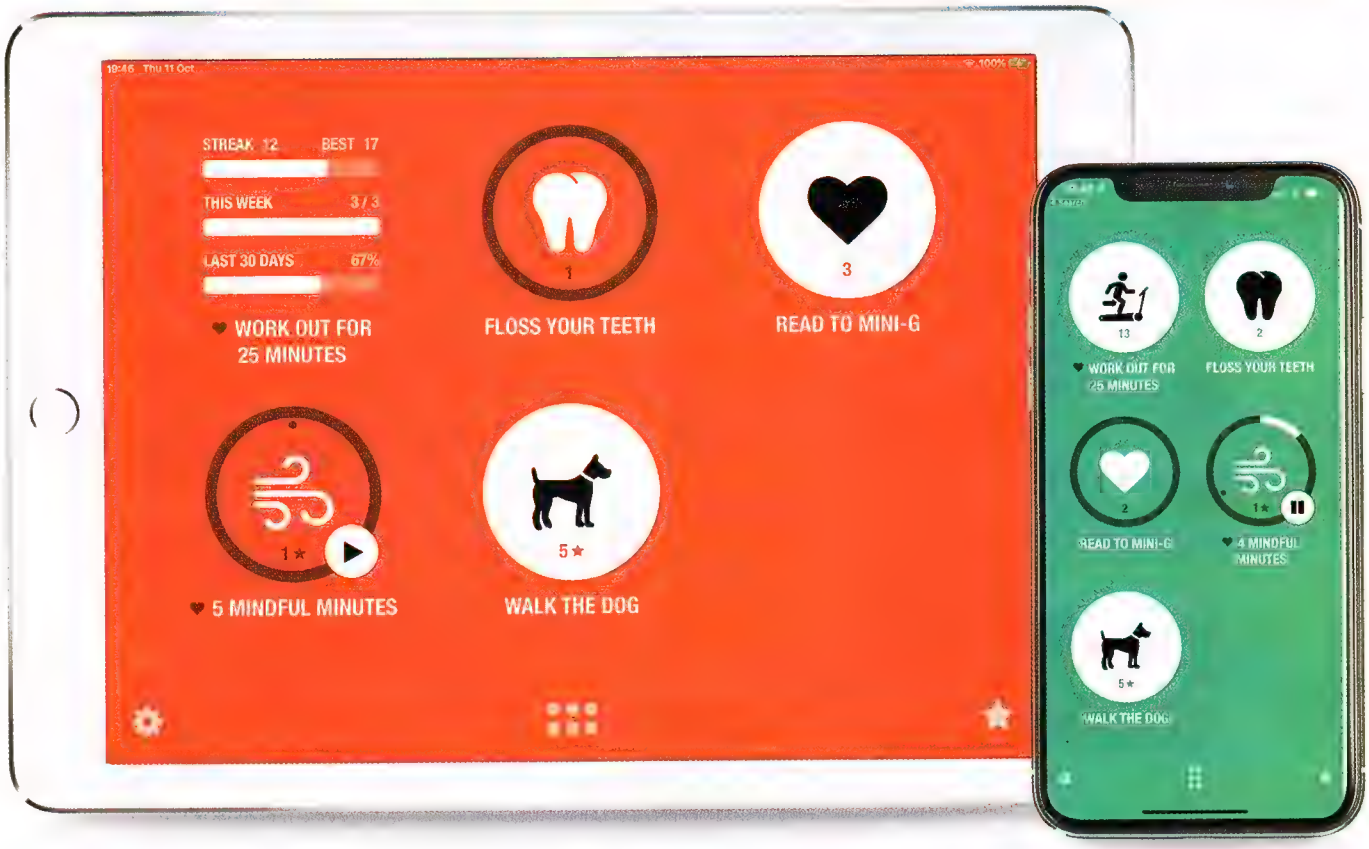
For many jobs it's just a matter of clicking the MyScrub button, which runs the most commonly used clean-up tools: removing unnecessary spaces, characters, tabs and carriage returns, capitalising things properly, and so on. But you can also create your own clean-up tools so, for example, if there are particular issues that keep coming up with text from certain sources, you can create a custom group of the relevant tools.

If an app uses macOS's Services, you can also invoke TextSoap from inside that app. There are two ways to do that: you can simply run your standard MyScrub tools automatically, or you can choose the appropriate cleaner from a pop-up menu. For example, if you're in your favourite text editor you can quickly wrap your text selection to a standard size, change quote marks or turn it into Markdown text.

CUSTOM CLEANERS

If you're already familiar with TextSoap, this latest edition introduces plenty of welcome features. The interface is much nicer than before and the built-in text editor is a pleasant place to work; you can import cleaners or share your own creations, and there's a new expression validator to check your custom cleaners for any issues.

TextSoap isn't for everyone, though: it's overkill if you only need to fix the odd messed-up thing in Word. But if you're routinely fixing or repurposing text, you'll wonder how you ever managed without it after you've tamed those unruly files. ■ **Carrie Marshall**



Streaks 4

An app to make a habit of using.

$7.99 | STREAKSAPP.COM | NEEDS IOS 9 OR LATER

There are likely things you want to be doing more of in your life, but don't – maybe you want to read a bit every day, you want to work out more, or you want to quit smoking. These things are not well suited to lurking on your calendar, nestled between work tasks and family events. But nor are traditional to-do managers geared towards habit-forming. Fortunately, Streaks is a handy to-do app blazing to your rescue.

Streaks wants you to stay focused and not overwhelm yourself. The main screen comprises up to six buttons, one dedicated to each task. There's a second page, but really you want to keep your habits to a minimum until they're fully infused into your routine.

Streaks is delightfully versatile due to a mix of task types and settings to choose from. If you want to floss your teeth every day, that's easy enough to set up (and comes complete with a huge tooth icon), and you can set a reminder to ping you a notification at the relevant time. Fancy working out a few times a week, but not sure on what days? Streaks can cater for that. Want to stop doing something? 'Negative' tasks can be created. Keen on strict sessions for a particular habit? Streaks will add a play button to the task which, when pressed, will transform it into an ad-hoc timer.

Items can be marked complete from the app icon's 3D Touch menu, a Today view widget or your Apple Watch (if you don't fancy opening the app itself). If you've got an iPad, Streaks now properly fits its screen, and your tasks and progress can be synced to iCloud.

Tap an individual habit button to see how often the task has been completed on a calendar. Tap again to see your streak count, target for the week, and percentage over the past 30 days. Tap and hold to view a larger, interactive calendar that you can use to mark days you forgot to add.

GLOBAL GOALS

A more global stats view is available from the star button. Here, you can view global or individual streaks, with bar charts and line graphs providing a visual indication of trends, including the time tasks were performed (providing you've marked items as complete when you've done them).

A smattering of customisation options (background colours, layouts, day and week start) and Siri Shortcuts support complete an excellent app for starting good habits or ditching bad ones. ■ **Craig Grannell**

SUBSCRIBE & GET APC FROM ONLY $5.79 AN ISSUE!

12 ISSUES FOR ONLY $79!

WHY SUBSCRIBE?

- Take advantage of our trial subscription offer of six issues for $49 if you choose to auto-renew*
- Get 12 issues of Australia's favourite tech mag for only $79!
- Save even more and get 24 issues for $139 – that's just $5.79 per issue!
- Free delivery of every issue straight to your door
- Free full-version software downloads with every issue

SAVE UP TO $99.80!

FREE DELIVERY TO YOUR HOME OR OFFICE EACH MONTH

HURRY

OFFER ENDS APRIL 22ND 2019!

TWO EASY WAYS TO SUBSCRIBE TO APC MAGAZINE

VISIT WWW.TECHMAGS.COM.AU
OR CALL (02) 8227 6486

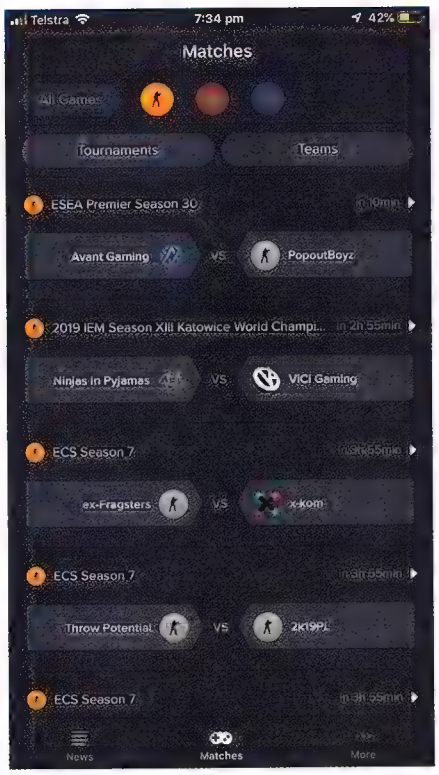
TERMS & CONDITIONS: This offer expires April 22nd, 2019, and is available to subscribers within Australia only. Please allow 6-8 weeks for delivery of your first issue. For full terms and conditions, see: **http://techmags.com.au/style/images/FutureTC.pdf** Please see our privacy policy on page 3. *Six issues for $49, then $49 charged to your credit or debit card every six issues thereafter on auto-renewal.

Luckbox News

Not great, but gets the job done

FREE | HTTPS://BLOG.LUCKBOX.COM/

Luckbox News is the latest in a long line of esports news apps that have been popping up lately. This one is basically a mobile-friendly version of website Luckbox, which is trying to build itself up as a betting platform. Curiously, there seems to be no way of placing a bet inside the app right now, but odds are (no pun intended) that will change down the track. With that in mind, there's a good chance that this app is going to serve a different purpose from the one it currently serves, which is worth remembering, especially with the gambling problems so many people suffer from in Australia. For now, though, it's a fairly unassuming app that focuses specifically on *Counter-Strike Go*, *League of Legends*, and *DOTA 2*. It gives you all the latest news, the match line-ups, when they're happening, and provides links to Twitch livestreams. It's a tad limited, but relatively professional by 'app version of a website' standards, and it makes following and watching matches easy. ■ James O'Connor

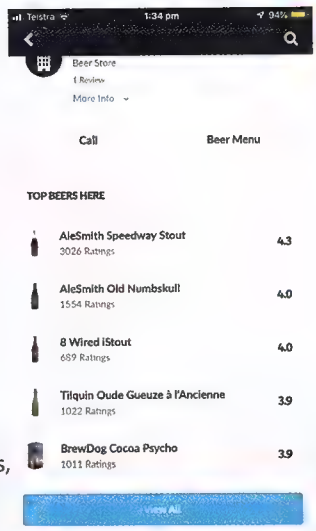


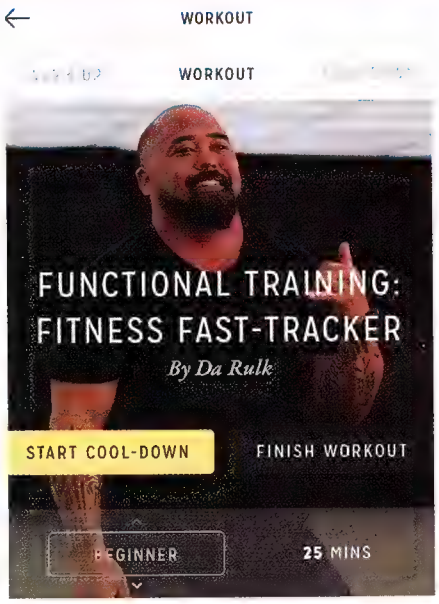
RateBeer

Bold flavour, smooth finish

FREE | HTTPS://WWW.RATEBEER.COM/

RateBeer has grown and improved since launch and is now at a point where it's a great app for anyone who likes to track their favourite beers and find cool recommendations. It lists nearby bars and bottle shops, gives you all their details, and tells you which of their beers in stock are highest rated. Often apps like this aren't heavily populated in the area I'm in (Adelaide), but RateBeer has extensive knowledge of my locals, what they have, and what I should be ordering. If a beer isn't available locally, it'll tell you where to go to get it, too. The rating is community driven, and users can assign ratings on a 50-point scale (0.0-5.0). They're picky – there are very few beers, it seems, that can crack a 4.0 – but the reviews tend to be quite detailed. This one's for beer connoisseurs, meaning that the top charts are largely dominated by European beers – as long as you don't get too upset that true Adelaide icon Coopers Pale only has a 2.7 rating, this is a great app. ■ James O'Connor





Before you start, visit the essential guide to learn the 9 key movements of Raw Functional Training.

Increase strength, balance and coordination in a series of everyday human movements. Multi-directional exercises force

Centr, by Chris Hemsworth

Food for Thor(t)

$20 A MONTH/$120 A YEAR | CENTR.COM

Centr's main selling point is the presence of Chris Hemsworth, and the notion that you, too, could look like him if you just change your entire life. The app features advice on how to train, recommended exercise routines, recipes, and general life and relaxation issues, complete with videos, images, and full articles. The daily planner gives you meal suggestions and workouts, although the expectations on your time are pretty high – if you're the sort of person who can handily buy for and cook two ingredient-heavy meals in one day, the app might suit you. It's quite pricey – cheaper than a gym, of course, but some of the exercises require equipment – and following along to videos on your phone can be difficult, especially since you're moving around and using your hands a lot. Centr is interesting, but it feels like an app for well-off people who need a bit more charisma in their workout routine rather than something that will help the average schlub – like me – improve their fitness. ■ James O'Connor

Grml 2018.12

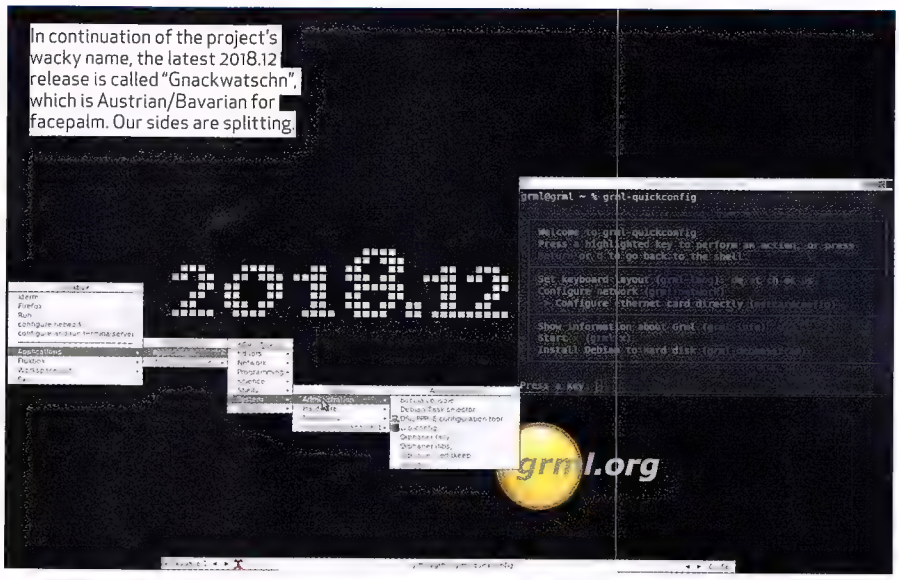
After having reaped some its benefits, Mayank Sharma leans back in his easy chair and wonders how he could get by without this distribution...

FREE | HTTPS://GRML.ORG

Named after the popular expression of anger and frustration (grrr), the Grml distro tries its best to calm the frayed nerves of a harried system admin. It packs an endless list of CLI tools, including several versatile utilities to help recover deleted files and fix common issues with both Linux and Windows installations.

The distro has the standard tools that any admin would want to use to rescue or recover data and troubleshoot a system. You can use Grml to manage all types of filesystems including Ext3, Reiser4, XFS, JFS and NTFS. It also bundles popular utilities for taking backups and cloning disks and partitions. But what makes this distro stand apart from its peers are its very set of custom grml- prefixed scripts, which will ease some of the common administration tasks.

The distro is available for both 32- and 64-bit computers in two variants. There's a 315MB variant that has a smaller subset of only the most essential utilities, and a larger 680MB variant with a huge collection of tools including some basic graphical ones, that we'll get to later. Early evidence of the distro's dexterity is the rich boot menu that lists various options, which enable you to use Grml in different ways. The options are listed along with a brief explanation to help you pick the right one.



In continuation of the project's wacky name, the latest 2018.12 release is called "Gnackwatschn", which is Austrian/Bavarian for facepalm. Our sides are splitting.

TIP OF THE ICEBERG

In addition to being an admin's toolbox, Grml can also be used as a Debian install disk. The grml-debootstrap script helps install a standard Debian installation with ease. You can also use the grml-terminalserver script to make the distro available to all the computers on the network via PXE. This, coupled with the previous script, makes it fairly easy to provision new machines on the network with little effort. There's also the grml-live script that helps remaster the ISOs. It comes in handy if you need a custom Grml spin. This script is based on the automatic installation (FAI) mechanism to create a customised ISO. But if all you need is to be able to store some settings that you want to survive a reboot, you can create and save them inside a persistent partition that can also optionally be encrypted.

The distro boots to the grml-quickconfig script that helps configure critical components of the system such as networking. You can also use the script to boot into the graphical desktop. Although all the admin tools housed in Grml are CLI-based, the distro itself contains a rudimentary graphical interface based on the barebones Fluxbox window manager. The one other graphical tool that you can access from inside the desktop is the Firefox web browser. The Fluxbox desktop does have an applications menu, but virtually all the apps, tools and utilities it lists fire up and run inside a terminal window.

One of the most touted features of the distribution is its zsh shell. Since the distro will primarily be used from the command line, the developers have spent time polishing its CLI. The Grml developers have customised the shell to include several useful keybindings, aliases and functions over and beyond the default zsh configuration. All the changes are documented in detail in the project's wiki and there's also a downloadable reference card that lists the important and useful shortcuts. The project has an extensive documentation infrastructure with detailed guides on core Grml utilities as well as documentation on various popular usage scenarios. There's also a pretty extensive FAQ, which will help orient first-time users.

Grml is a well-rounded effort and while it won't impress desktop admins looking for shortcuts or graphical interfaces to troubleshoot their system, it's perhaps the most comprehensive toolbox for seasoned veterans who know what they are doing. ■

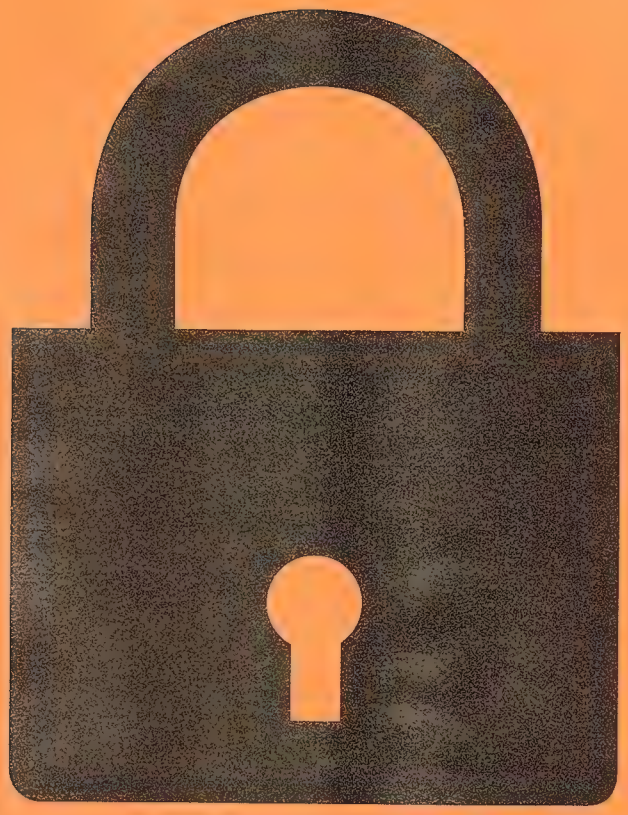
THE 2019 BACKUP GUIDE

NEVER LOSE A FILE AGAIN!

* DISCOVER THE EXPERT WAYS TO MAKE YOUR FILES SAFE
* SAVE YOUR WINDOWS AND MAC SETUP
* IMMUNISE YOUR PC OR MAC AGAINST DISASTER

PAGE 45
PC BACKUP GUIDE
Immunise yourself against disaster with our guide to backing up (and restoring) your critical data.

PAGE 54
MAC BACKUP GUIDE
Discover the expert ways to make your files safe.



NEVER LOSE A FILE AGAIN

Immunise your PC against disaster with our guide to backing up (and restoring) your critical data

Excuse us for being that bore who bangs on about backups, but how do you protect yourself against data loss and possible disaster? If the answer is not at all, you need to stop what you're doing right now and take critical steps to protect yourself from future disaster.

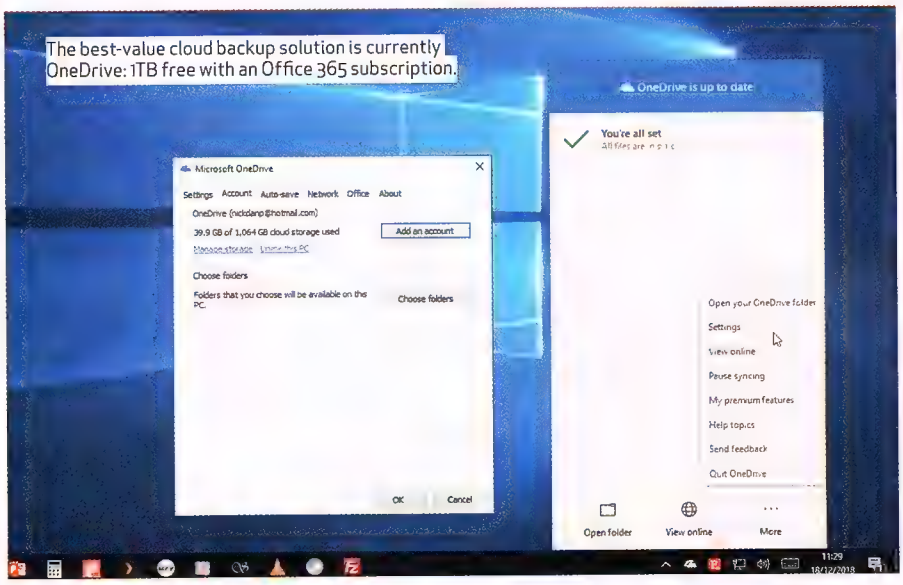
Everyone has a story about data loss – ours dates to 1999 when we spent 24 hours painstakingly recovering files one at a time from an accidentally wiped hard drive using primitive data recovery software. We got lucky that time, but the lesson was learned – now we take backing up deadly seriously and who cares if we're not the life and soul of the PC party? At least we're not sobbing in the corner having lost a lifetime of memories and irreplaceable documents.

In this guide we'll point you in the direction of the backup devices you need. We'll introduce you to one free program that can cover all your backup needs – and, of course, critically we'll show you how to set it up. You'll learn how to back up all your important files, plus take a failsafe drive image of your entire Windows installation so future calamities are rendered little more than minor inconveniences. Speaking of which, if – or more likely when – disaster strikes, we'll show you how to get your data back again. Enough chit-chat, it's time to back up.

Choose your backup devices

Step one is working out where to store the critical copies of your data – both offline and over the internet.

The first thing you need to do when setting up your backup regimen is to ensure you have at least two suitable backup destinations in place. One should be 'local', as in the same room (or network) as your PC, so typically an external drive of some kind, connected via USB or network cable. The other should be 'remote', so housed in a separate location in case you're subject to fire, theft or damage.



The best-value cloud backup solution is currently OneDrive: 1TB free with an Office 365 subscription.

NETWORK VERSUS USB

When it comes to your local backup location, you've a straight choice between a drive directly attached to your PC, or a network hard drive (also known as a NAS – Network Attached Storage). The latter is accessible to other PCs in your network, so if you're looking to set up a backup regimen for your entire household, this could be more cost-effective.

That said, you need to ensure that everyone has sufficient backup space – you can get a rough guesstimate by asking everyone to open File Explorer, browse to C:\Users, right-click their personal user folder and choose Properties. Add that figure to the current size of drive C, then double it to ensure they have enough space in the medium term for backing up to.

You then need to add these figures together to arrive at the size of NAS drive you'll need for everyone in your household. Then investigate the cost of a single NAS drive versus individual USB drives to see which is more cost-effective – a 4TB NAS drive might turn out more expensive than four 1TB drives, for example.

Network drives have other advantages above and beyond mere centralised backup devices, though – the more you pay, the more flexible they can be. There's another reason why a NAS might be better than simple USB drive – it can also serve as an alternative to a cloud-based backup (see the box below).

BACK UP TO THE CLOUD

Your second backup should be housed in a remote location. The expensive-but-secure option would be to invest in two identical network drives: one for your own home; another in a trusted remote location (say a friend or family member). You'd then back up to your own network drive as part of your primary backup and then mirror it to the remote drive, typically using a technology known as Remote Replication, which works over the Internet.

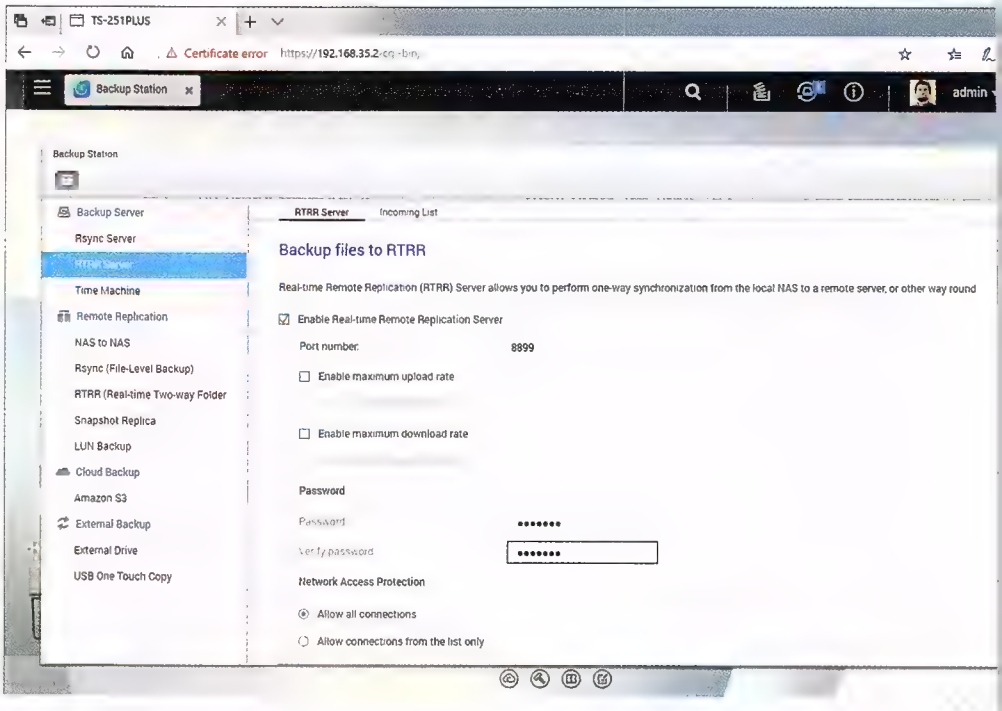
This involves a hefty up-front

Your personal cloud

If you want the convenience of cloud storage – the ability to keep data synced between multiple computers and accessible via mobile devices, for example – but don't want to store it on the web, look to invest in a hardware solution in the form of a network hard drive, also known as a NAS (Network Attached Storage). More powerful solutions offer a built-in personal cloud solution where the central copy is stored on the drive itself. If you're particularly concerned about security, you can restrict access so only devices directly connected to your local network have access.

Most NAS manufacturers offer their own proprietary solutions – My Cloud for Western Digital, for example. This is adequate for most people, but if you want a non-proprietary solution, you should look to invest in a more expensive NAS drive from companies like Synology and QNAP. These offer support for open-source alternatives, such as NextCloud and OwnCloud, as well as their own proprietary cloud apps. You might also want to explore setting up a VPN server on your NAS to give you access your files on the go without directly exposing them to the Internet.

Don't trust third-party cloud providers? Then turn your own NAS into a cloud backup server instead.



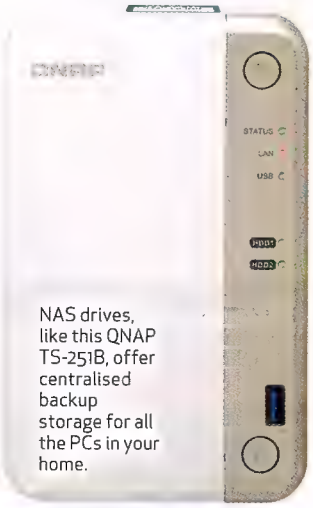
If you have deep pockets you could back up one NAS to another – and even have one housed at a different address.

investment and requires a willing friend or family member with unlimited Internet access to house the remote drive. You could mitigate the cost by convincing them to buy their own drive and then enable them to mirror their backups to your drive as part of a reciprocal arrangement.

A more convenient solution is to use a cloud backup solution. The simplest one to use is OneDrive, since it's already built into Windows. You only get 5GB of free space these days, but if you pair it with an Office 365 package, you get 1TB along with use of Office for a year. Office 365 Personal for one user (multiple devices) costs $10 a month (or $99 a year), while Office 365 Home covers up to six separate users for just$13 a month or $129 a year.

If you don't need Office – never mind 1TB of space – then Google Drive is a good alternative. 15GB is provided free, or pay $2.49 a month/$24.99 a year for 100GB, which should be ample for your key data files. It's all linked into your Google account – head over to **drive.google.com**, click the Settings button and choose 'Get Backup and Sync for Windows' to get started.

Worried about the security of cloud storage? Files are encrypted before they're uploaded, but the encryption keys are often held by your cloud provider, meaning they could technically be handed over to a third party. If that's a deal breaker, and you can't afford the NAS option, you have two options. One, choose a more expensive cloud provider that offers end-to-end encryption, which means they have no access to your keys. SpiderOak (**https://spideroak.com/**) is one such provider – its SpiderOak OneBackup plans start from US$5 per month (US$59.99 a year) for 150GB of storage. Alternatively, check out the box below on Cryptomator. This free tool adds a secondary layer of encryption (one you control) to your most sensitive files, and works with any cloud provider, including OneDrive and Google Drive.

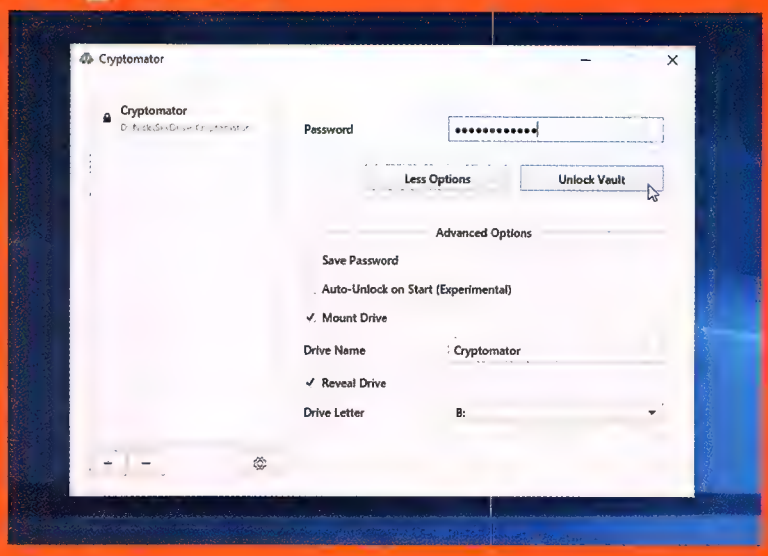


NAS drives, like this QNAP TS-251B, offer centralised backup storage for all the PCs in your home.

Encrypt twice, back up once

If you can't afford a dedicated NAS solution, but don't trust cloud providers to look after your data either, why not add an extra layer of encryption to that data using a free client-side tool like Cryptomator (**https://cryptomator.org**).

Cryptomator creates a special vault – a virtual drive inside which all your most sensitive files can be stored, which resides in your cloud folder. The vault's contents are encrypted by Cryptomator before they leave your PC, and the encryption keys remain off limits to your cloud provider (or anyone else). The vault itself functions like a regular USB drive, although there's a performance hit as files are individually encrypted when copied into the vault or updated inside it. Rather than save directly to the folder, then use it as a secure backup destination for Paragon Backup and Recovery when backing up data files. Not only is decryption kept to a minimum, you retain an unencrypted copy of your files on your PC in case anything happens to the vault, like forgetting your password.

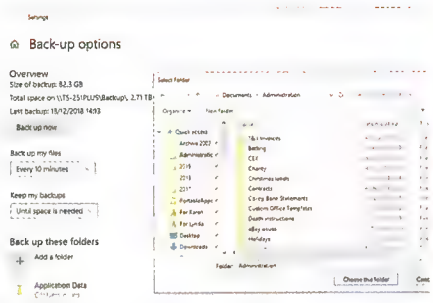


Back up your data

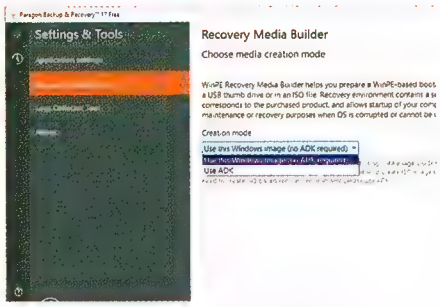
Implement no less than three different back-up regimens to help protect your most critical files from data loss.

Let's start with backing up your data files. These are typically files you've created yourself, such as documents, photos and videos. Their personal nature makes them irreplaceable if lost, which is why you should back them up separately from the rest of your PC.

When backing up, it also pays to store multiple versions of your files, giving you the opportunity to roll back to an earlier version if you accidentally save unwanted changes. This functionality is built into Windows in the form of File History, which you can set up by clicking Start > Settings > Update & Security > Backup. If you've not already set it up, you'll be prompted to do so now by choosing a backup drive to save to. Click 'More options' to choose exactly what to back up – key user folders should automatically be included, but if you store data outside these (say on another internal drive or partition) then click 'Add a folder' to add those too. Other options include frequency of backups (with versions taken every ten minutes if required) as well as how long to keep backups for.



Ensure File History is backing up the folders you need, and determine how often they're backed up.



If you install Paragon Backup & Recovery Free, be sure to create rescue media, too.

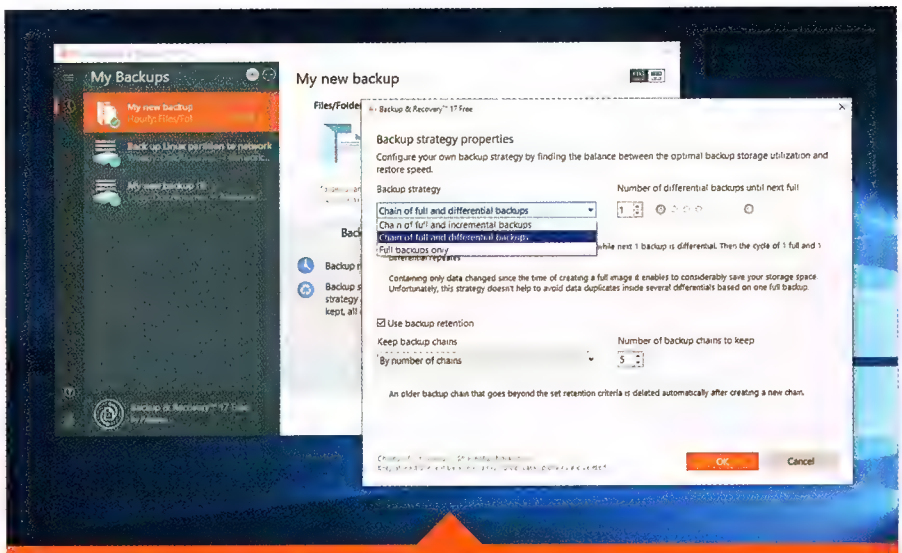
OTHER BACK-UP OPTIONS

If you want the security of an additional backup, download and install Paragon Backup & Recovery Free from **www.paragon-software.com/free/br-free/** (free, registration required) – this can take both file-based and image-based backups. The step-by-step guide on the page opposite reveals how to set up your own set of full and incremental backups, giving you the luxury of daily versions to choose from. If you have two backup devices to save to – say a USB drive and a network drive – consider saving this job to a different drive to File History for greater data redundancy, or to your cloud drive using Cryptomator to provide additional encryption as described earlier.

When you first launch Paragon, you'll be prompted to create rescue media, which is needed for emergencies or when recovering entire drive images. For now, either click to follow the prompts or click the Settings button in the program and choose Recovery Media Builder. Insert an unused USB flash drive that's 512MB or larger. Select 'Use this Windows image...' under 'Creation mode' before clicking Next and following the steps to create that potential lifesaver.

The final backup you need to configure is your cloud-based backup. OneDrive, Google Drive and so on typically create their own folder inside which you store your data separately to your regular user folders. If you go down this route you might want to direct Windows to use the sub-folders inside your cloud folder instead of the regular user folders: open File Explorer, right-click Documents and choose the Properties > Location tab. Click 'Move', then point it to the Documents sub-folder inside your cloud folder (for example, OneDrive\Documents or Google Drive\Documents). Click 'OK' and agree to move your existing files to the folder so they're easily accessible. Repeat for your other user folders.

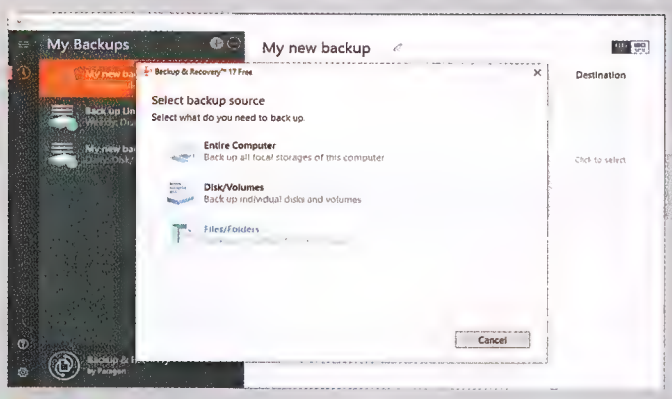
Going forward, not only will your user folders automatically stay synced with the cloud (where again multiple versions of your files are stored), but they'll also be included in your local backup jobs for that extra level of security.



Reduce backup space

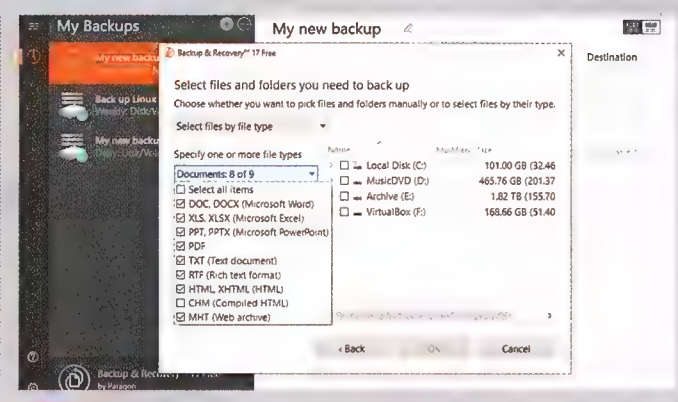
Back-up tools like Paragon and File History employ clever techniques to help keep the size of your backup to a minimum as new changes are recorded. After a single full backup is taken, Paragon offers two types: differential, which record the changes made since the last full backup was taken; and – better still – incremental, which only records those changes made since the last incremental backup was taken, helping keep the size of your backup down even further. If offered a choice between the two, choose incremental to maximise free space; if free space isn't a problem, differential backups are quicker to restore from.

Back up your files with Paragon



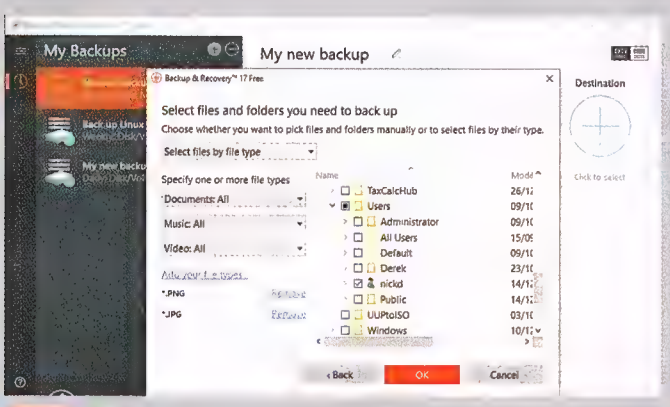
1 CHOOSE FILE-BASED BACKUP

From the main screen click '+' next to My Backups. Click '+' under Backup source to select Files/Folders. You can opt to choose specific folders or drives to include in your backup – tick a box or click '>' to expand a drive or folder to view its contents before ticking what you wish to back up.



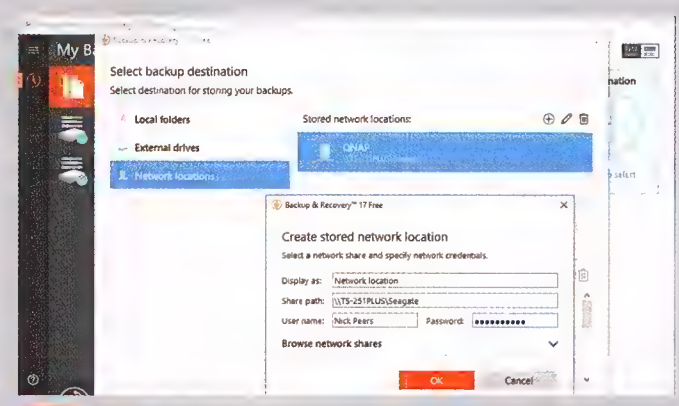
2 BACK UP BY FILE TYPE

Alternatively, choose 'Select files by file type' to choose specific types of files such as documents, music or video. Click the down arrow next to each to see which file types are included in the selection. From here you can exclude selected file types by unticking them as shown above.



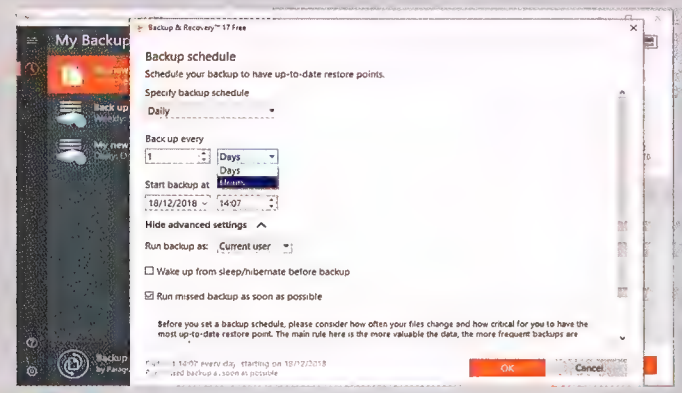
3 MORE FILE-TYPE OPTIONS

Click 'Add your file types' to enter your own choices manually – for example, '*.jpg' for JPEG files, then '*.png' for PNG. Once done choose which specific locations – drives and/or folders – to search for files matching your selected types, before clicking OK to complete your selection.



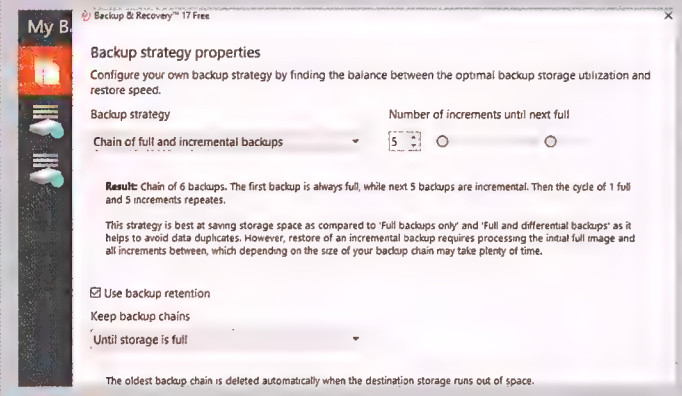
4 SELECT DESTINATION

Click 'Destination' to choose where to store your backup. Select another internal drive (one your data isn't already on) under Local Folders, or choose 'External drives' to select an attached drive. Pick 'Network location' to select a networked drive, with username and password if required.



5 SET BACKUP SCHEDULE AND STRATEGY

Click 'is not scheduled' to choose when to back up your data. To improve your chances of recovering lost data, choose a Daily backup schedule and then change it to Hours (as shown in the screenshot above) to back up your data multiple times a day – this can be as often as once per hour if you wish.



6 SET BACKUP STRATEGY

To reduce the size of your backups, click 'Full backups only' under Backup Strategy. Choose 'Chain of full and incremental backups' and change the number to 6. Leave 'Use backup retention' ticked and then choose how long to keep your backups (see main text). Click 'OK' > 'Back up now'.

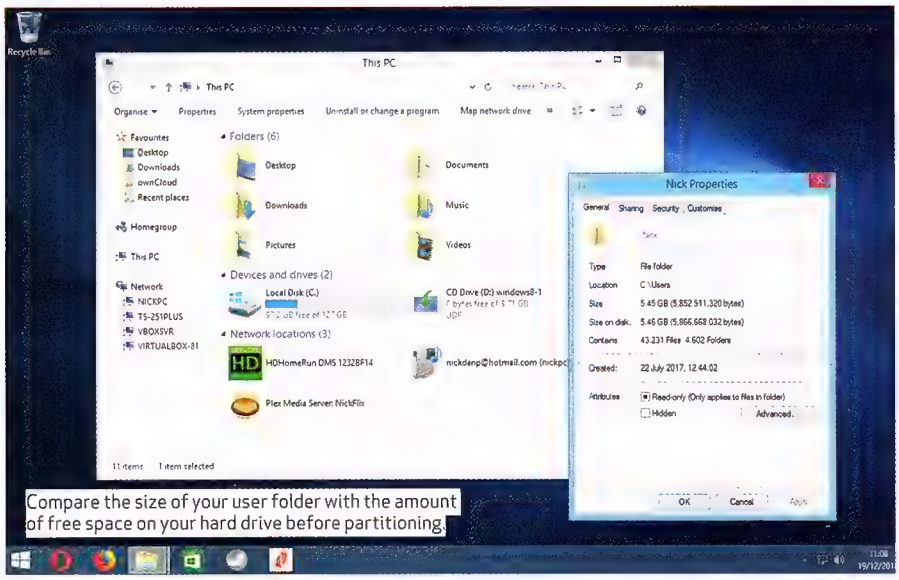
Back up everything

Protect your entire Windows installation – including apps and settings – from harm with a full drive image.

Your data is now backed up, ensuring your precious files and memories are protected. But what about the rest of your computer? What if you've inadvertently missed a critical folder or file? And what about Windows itself, along with all your applications and carefully crafted program settings? If Windows falls over, you could lose these, never mind the hours required to bring everything back up to speed. The solution lies in taking what's known as a 'drive image'.

As the name implies, a drive image is a complete copy of one or more drives or drive partitions on your PC. The next time you run into problems – after a botched Windows Update, say – you can simply roll your computer back to its previous self within minutes, with nothing lost but the changes made since the last drive image was taken.

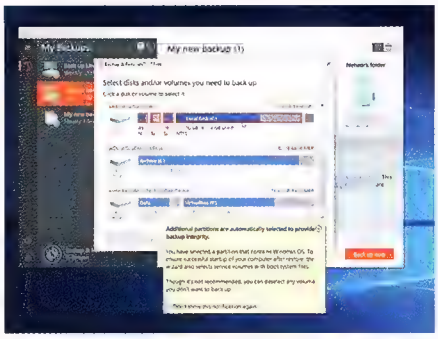
If you currently protect your PC in this way using Macrium Reflect Free (**www.macrium.com/reflectfree**), there's only one reason to consider switching to Paragon Backup and Recovery Free (**www.paragon-software.com/free/br-free/**): the latter's support for incremental drive images. Incremental changes take up less space than differential ones, so switching to Paragon would make it more practical to back up your Windows installation on a daily – rather than a weekly – basis.



Compare the size of your user folder with the amount of free space on your hard drive before partitioning.

TIME TO PARTITION?

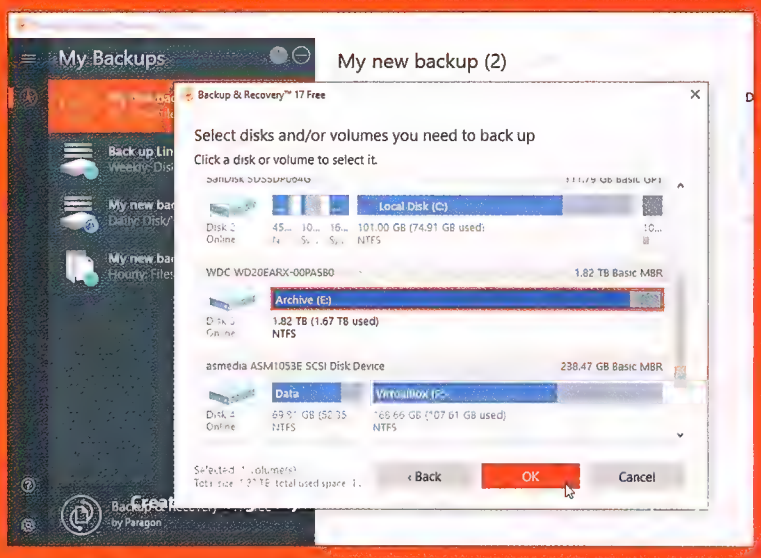
One of the major drawbacks of a drive image is the fact that you roll your entire system back when you restore from your backup – and that includes all the files on the drive, including your data files. This means if you had to restore a backup from a week ago, all the changes you made in the intervening period would be lost unless you then went through the rigmarole (explained over the page) of


Paragon selects all the partitions needed to boot Windows as part of its drive image automatically.

More drive images

As things stand, your backup regimen now protects you from disaster, but why not go further? Paragon supports multiple back-up jobs, so you could, for example, take a single drive image the next time you reinstall Windows after you've finished setting things up. Next time you need to reinstall, just restore this drive image and save yourself time getting things set up.

If you partitioned your drive to hive off your data from Windows you might also want to take periodic drive images of that too, in case your regular backup inadvertently misses out certain files. Here a chain of backups comprising one full and three incremental or differential backups on a weekly schedule would prove adequate without taking up too much space on your drive backup. If you go down this route, consider storing this backup on a separate drive to your regular file-based one – for added security. As you'll see over the page, you can recover individual files from drive images as well as simply rolling back the drive, making it a practical backup for your data backup.

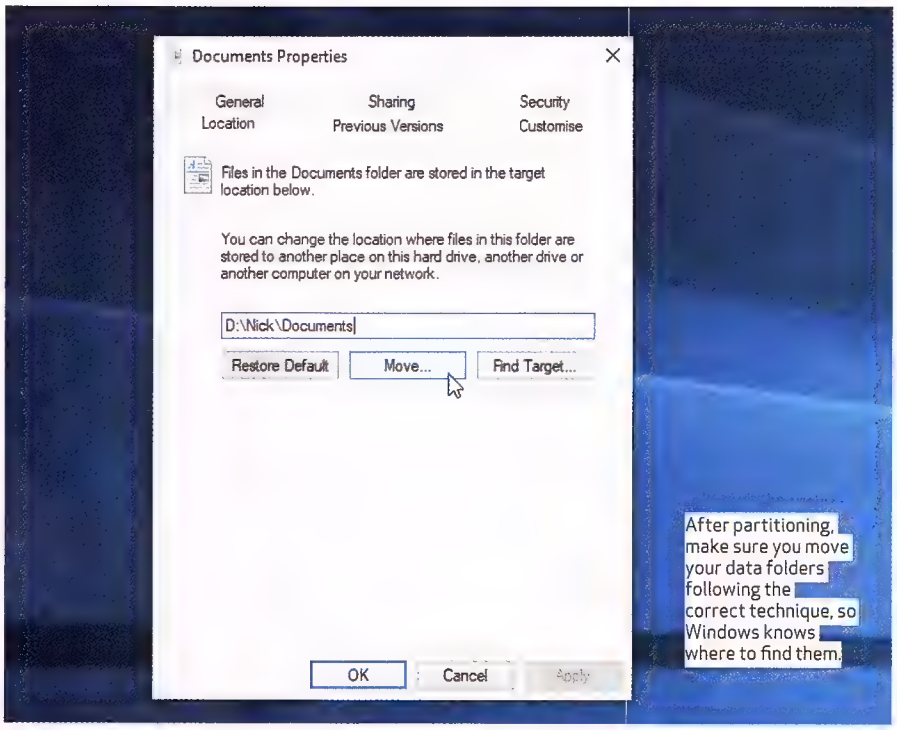


restoring the latest data backup after restoring your drive image.

One way to mitigate this problem is to partition a drive in two. This enables you to move your data to the secondary partition, separating it from Windows. That way, when you roll back your Windows partition your data remains untouched. Our go-to tool for partitioning is AOMEI Partition Assistant Standard Edition (download it for free from **www.disk-partition.com**). After launching for the first time make sure you first click Make Bootable Media under Wizards to create a rescue disc, just in case something goes wrong.

Next, open File Explorer and select This PC. Make a note of how much free space is currently on drive C. Now browse to C:\Users, right-click your user folder and choose Properties, if you haven't already done so, to ascertain its current size. If the folder is larger than the amount of free space left on drive C, you'll need to temporarily move its contents to another drive. Once done, follow the step-by-step guide below.

One final step: it's not enough to move your folders to your newly-created data partition, you need to let Windows know where they've gone to, too. Open File Explorer, then right-click each of your personal folders (Documents, Downloads and so on) in turn, choosing Properties, then the Location tab and clicking Move to point them towards folders on your data partition. When prompted, opt to move your existing files across. Don't forget to move your cloud backup folder, too, if necessary.



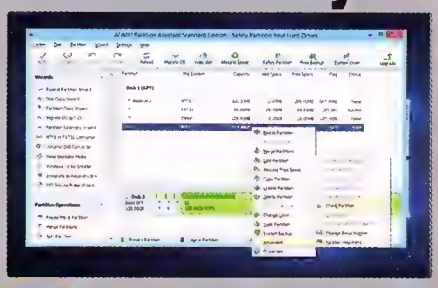
After partitioning, make sure you move your data folders following the correct technique, so Windows knows where to find them.

TAKE YOUR BACKUP

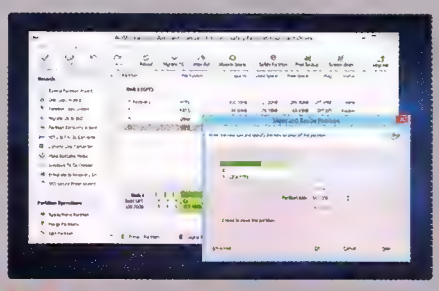
Once you have partitioned your drive – or skipped this step if you're happy to keep your data and Windows on the same drive – it's time to set up your image. Open Paragon Backup and Recovery Free as outlined on the previous page. Click the '+' button at the top next to My Backups. Click 'Backup Source' and select Entire Computer if you're backing up a single drive or 'Disk/Volumes' if you've partitioned your drive drive. In the case of the latter, identify the drive with Windows on it and click 'Local Disk (C:)' – you'll notice that Paragon automatically selects the small partitions to the left to ensure you also back up the all-important boot partitions, too. Click 'OK'.

The rest of the process follows the same path as backing up individual files as outlined in the previous section: choose your destination, pick a schedule – once a day should be sufficient – and select the incremental option under 'Backup strategy'. We'd advise creating a chain whereby a full backup is created weekly, with six incremental backups in-between. You can then choose whether to keep all your backups until space runs out or limit them to a specific number – remember each backup chain equates to a week's worth of backups, so there's probably no reason to keep more than one or two. Once that's done, click 'Back up now' and wait for your first drive backup to complete; subsequent backups will take place in the background.

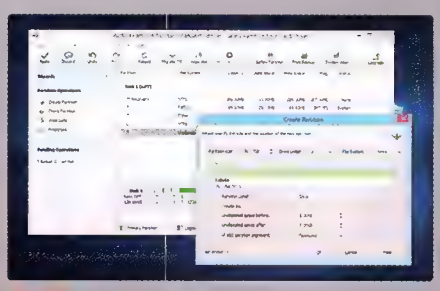
Partition your drive



1 VERIFY PARTITION
Open the free AOMEI Partition Assistant app, right-click the C drive and choose Advanced > Check Partition. Perform a simple partition check – if errors are found, click Yes and wait while your PC reboots and the Disk Check tool attempts repairs. If necessary, re-run the check until no errors are found.



2 SHRINK YOUR C DRIVE
Select drive C again, only this time choose Resize/Move Partition under Partition Operations instead. Use the slider to reduce drive C's size to leave sufficient space for your data partition – as a rule, leave a minimum of 10GB free on drive C for future programs and apps to occupy – then click OK.



3 CREATE A PARTITION
Finally, select the unallocated space and click Create Partition. Check that NTFS is selected – you'll notice it'll be allocated the next available drive letter, which won't be D. Click 'Advanced >>' to label the drive (Data, for example). Click 'OK' followed by Apply and Proceed, to reboot and partition your drive.

Recover your backups

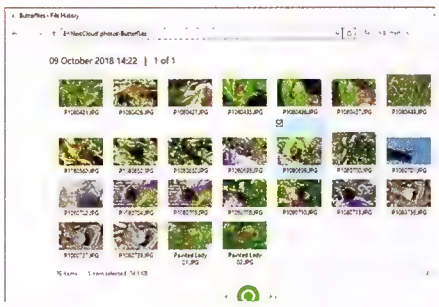
Discover how to restore files and drive images to bring back data and get Windows working properly again.

The unthinkable has happened. You've lost a file or – worse still – Windows won't boot. This is the moment when all the hard work you've undertaken to protect your data comes riding to the rescue. In this portion of the feature we'll reveal how to get things up and running again with a minimum of fuss.

RECOVER FROM FILE HISTORY

If you're looking to restore a lost or accidentally deleted file – or undo recent changes to a file – your first port of call is your data backup. Start with File History – type file history into the Search box and click 'Restore your files with File History'. A window will open showing all the folders currently in your backup, along with the date the backup was taken. If you're simply looking to recover the latest version of a file, start your search here – you can browse the folders or use the search box if you know all or part of its name.

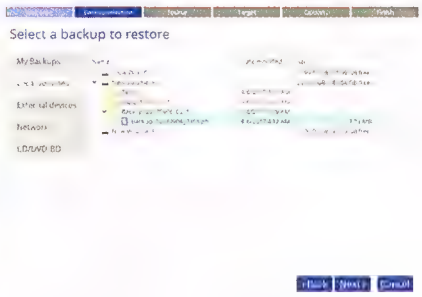
When you have found your file, double-click for a preview if supported (documents, text files, photos and so on) to verify it's what you're looking for.



File History lets you recover earlier versions of files as well as restore lost or deleted data.

Use the navigation controls at the bottom to move between different versions if you're looking to restore an earlier version of the file. When you've found the one you want to keep, click the green button at the bottom to restore it to its initial location. If you wanted to save a copy of the file rather than restore it, select the item before clicking the settings button in the top-right corner and choosing 'Restore to'.

Recovering files from your cloud provider works in a similar way, except you'll need to log on to it through your web browser. If you're using OneDrive, head to onedrive.live.com and then either browse or perform a search using the tools provided. Earlier versions of files can be accessed by ticking the file and clicking the 'Version history' button at the top of the screen, for example.



You'll need to boot from your Paragon rescue USB flash drive to restore partitions or drives.

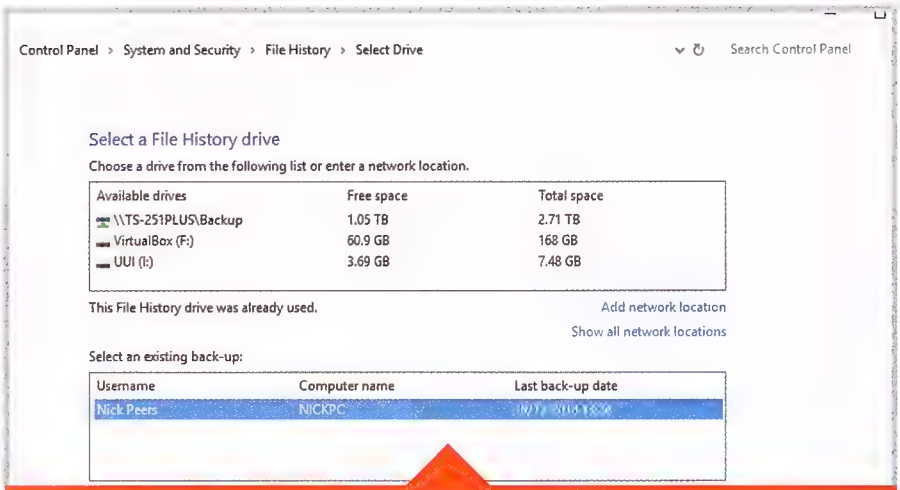
RESTORE FROM PARAGON

The step-by-step guide on the page opposite reveals what to do if you want to recover individual files from your Paragon backup, whether it's from a file-based backup or full drive image.

If you want to recover entire partitions or disks, you'll need to boot from your Paragon Backup and Recovery boot flash drive. Restart your PC with the drive plugged in and look for an option to select the boot drive at startup. Press this key and then select the flash drive – if two options are provided, try the UEFI option first.

When the rescue environment appears, choose 'Restore backup', click Next and then use the options to navigate to where your backups are stored. After checking the backup isn't corrupt, leave Disk/Partition selected and click all the available partitions to restore them to their original locations. Review your changes and then restore the backups, rebooting to bring your PC back to working order.

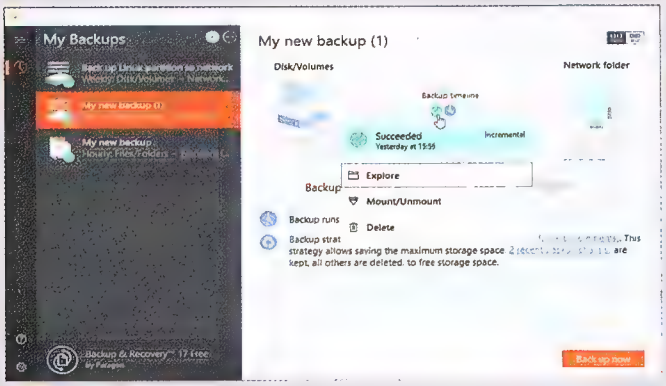
While your PC is working correctly, we recommend downloading the program's help file, which provides more detailed guidance on restoring your PC, and offers various step-by-step guides to different disaster scenarios you may encounter. Click the Help button in the app followed by 'View help' to access it in PDF format through a web browser.



Reconnect File History

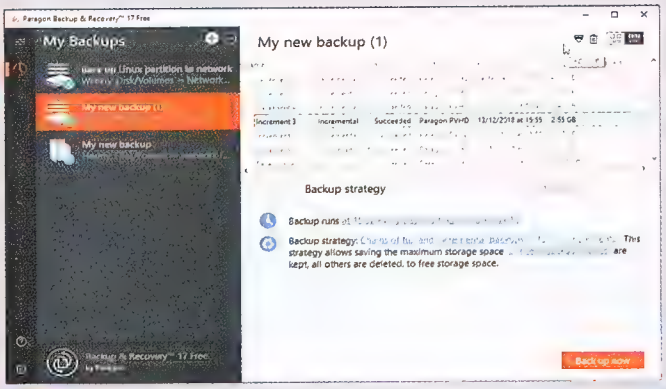
If Windows ever loses contact with your File History backup drive – for example, after reinstalling Windows from scratch – then reconnecting it should be handled with care. Type **control panel** into the search box, click Control Panel and choose 'Save backup copies of your files…' under 'System and Security'. Click 'Select drive' and, if necessary, 'Add network location' to connect to your backup drive. Select this and you should see an option to select a previous backup to reconnect to it. Once done, you can continue backing up as before, plus recover data from this backup if you need to.

Recover from Paragon Backup and Recovery



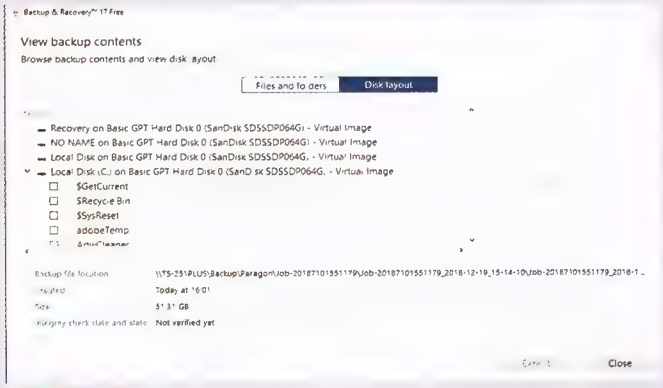
1 SELECT BACKUP

You can restore individual files and folders from within Windows itself – launch Paragon Backup and Recovery and select your backup from the left-hand pane. Roll your mouse over the dash immediately to the left of the clock in the Backup timeline to view its type and when it was taken.



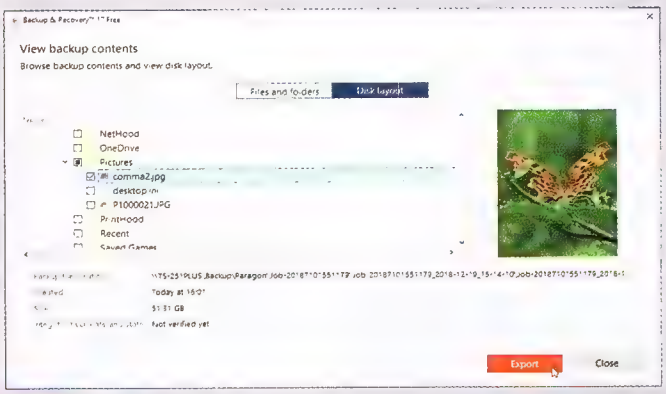
2 CHOOSE VERSION

To explore earlier backups, switch to the Table Layout view by clicking the button in the top right of the main screen. Select your chosen backup, then click the folder button as shown above, which will enable you to explore its contents within Paragon Backup and Recovery.



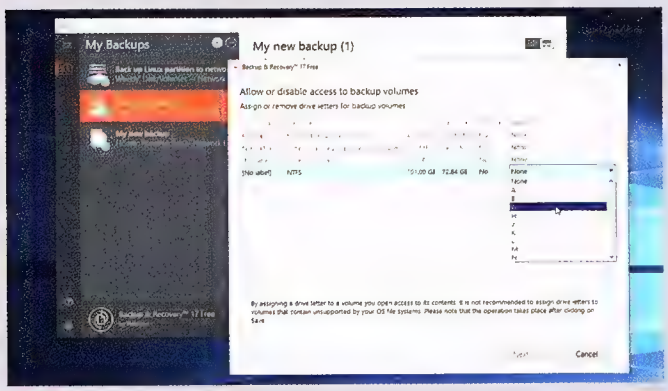
3 EXPLORE CONTENTS AND RESTORE

Make sure you're on the 'Files and folders' tab. You'll need to know which folder your missing file is in (hint, data files are usually found under C:\Users\<your username>). Browse the drives and folders expanding and scrolling through the list until you find your target folder.



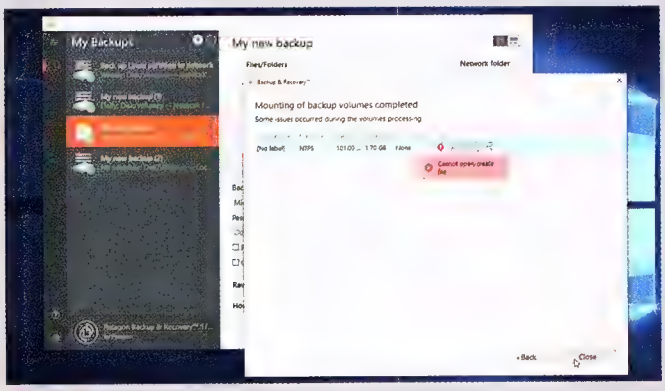
4 PREVIEW AND RECOVER

When you've spotted your file, click it to highlight it. If it's a supported file type – photo, document or text, for example – then a preview will appear. If it's the correct one, tick the box and click Export. Use the folder browser to choose where to save it. Click 'Next' to save the file.



5 AN ALTERNATIVE APPROACH

If you are struggling to find the missing file, click Close. Select the backup again, only this time choose Mount/Unmount. Select the drive from the list and assign it a mount point – this is basically a drive letter that will help you identify it in File Explorer – before clicking Next.



6 BROWSE BACKUP AS VIRTUAL DRIVE

If successful, your backup will appear as a drive in File Explorer, ready to use like any other (no changes to the drive are saved, but you can search for and copy files from it). However, you may run into problems with the drive failing to mount; if so, you'll have to revert to the simple restore method instead.

BACK UP EVERYTHING

DISCOVER THE EXPERT WAYS TO MAKE YOUR FILES SAFE.

CLOUD BACKUPS EXPLAINED

Cloud backups refer to making a copy of your data over the internet to a server. Along with a physical backup they can be incredibly convenient.

With more Macs than ever running on reliable SSDs (instead of older hard drives) and iCloud providing an automated backup service for iOS devices, it's easy to think that creating backups doesn't matter anymore. The truth is that having a solid backup plan for your Mac and iOS devices is just as important as ever. Fortunately for you, that's what we've come up with here.

When it comes to backing up any device there are two rules. The first is to automate backups as much as possible. For iOS, Apple makes this easy with iCloud, backing up your iPhone or iPad every time it's on charge, connected to Wi-Fi and sleeping. For Mac, though, things are a little more difficult. There's no automated iCloud backup option to be had, so we've detailed a few alternatives in these pages.

The second rule is to back up your data in at least two different locations. After all, if your backup drive and MacBook Pro are in the same bag when it gets stolen it will be like you never backed up at all. We'd recommend both a local, physical backup (to a hard drive or Time Capsule) and one in the cloud. Read on and you'll find solutions for both of these.

If it wasn't already obvious, backing up your iOS devices is easier than ensuring your Mac's data remains safe, so we've given a healthy chunk of this feature over to our macOS-running devices. Even if you're a sole iOS user you'll still find plenty of useful information. Let's get started.

BACKUP DEVICES

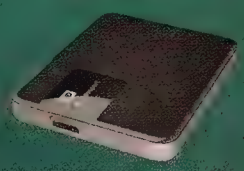
THREE OF THE BEST BACKUP STORAGE OPTIONS AVAILABLE

Buying drives for backups opens up a world of options. Here we've listed a few of our favourite choices in a range of prices. If you're still not sure where to start, why not go for the cheapest option and upgrade later?

APPLE AIRPORT TIME CAPSULE

$370 (2TB)

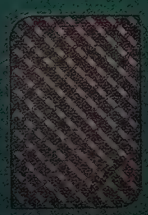
Apple's own option doubles up as both a Wi-Fi base station and a wireless backup drive. However, it's not sold locally and you'll need to order one from overseas.



WESTERN DIGITAL MY PASSPORT FOR MAC

$99 (2TB)

Western Digital's My Passport for Mac drives have been around for a long time and have earned a reputation for being portable, reliable and ready to work straight from the box.



VERBATIM STORE 'N' GO USB 3.0 HARD DRIVE

$142 (2TB)

Verbatim's portable drives use USB 3.0 for speedy data transfer, don't require an additional power supply and come in a range of sizes from 500GB up to 5TB, perfect for handling all of your backups.

Set up and use Time Machine

Get the most from Apple's automated Mac backup solution.

If you're looking for a quick way to start backing up your Mac, look no further than Time Machine. All you need is a hard drive, and the software is free and installed on every Mac. Once you've set it up keep your hard drive plugged in and your Mac will regularly back up automatically. We'll show you how to get started and how to make Time Machine work even harder with a few tweaks.

BACKING UP MANUALLY

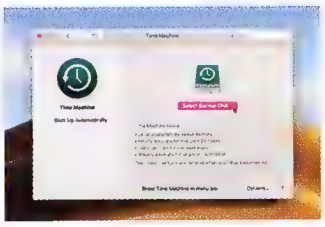
If you unplug your Time Machine backup drive you'll no longer be backing up regularly, so you need to remember to connect it up at least once a week.

1 CONNECT DRIVE

Grab a hard drive and hook it up to your Mac. Ideally, you'll want a fresh new one with at least double the space of what you have with your Mac's internal storage.

2 THE PREFERENCES

If you're not prompted with the option to use your drive as a Time Machine drive, head to System Preferences and then click on the 'Time Machine' pane.



3 SELECT A DISK

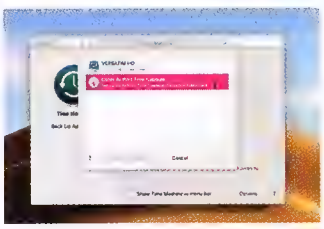
Click the 'Select Backup Disk' button to see available hard drives and select one to back up to. You can even select multiple drives for copies of your backup.

4 ENCRYPT DATA

When you select your drive you'll have the option to encrypt your backups. This is great if you're concerned about sensitive data, but the backup may take longer.

5 EXTRA OPTIONS

The Options button in the bottom-right corner will bring up some extra options, such as excluding specific files or folders from the backup and delete notifications.



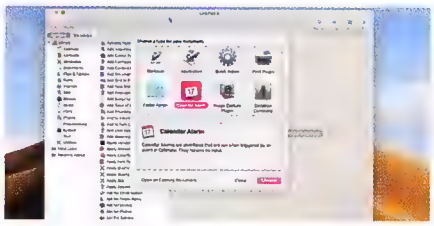
6 ADDITIONAL DRIVES

Selecting another Time Machine drive with one already in use gives you the option to replace the original or add another for extra copies of your backup.

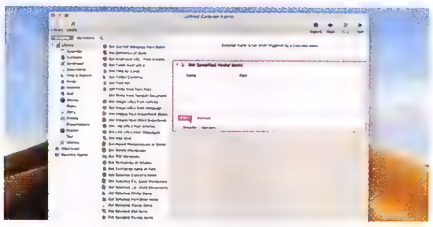
Back up automatically with Automator

Create a simple automated backup workflow.

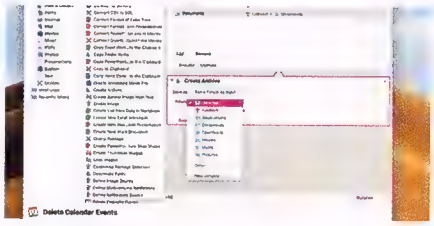
Following these steps will set up a simple Automator workflow that creates a zip file of important files and copies them to Dropbox every week. Dropbox is a file-syncing service that lives on your Mac and syncs items to a folder on the cloud. It's not a full backup solution, but paired with Automator it's a convenient way to save an extra copy of your stuff.



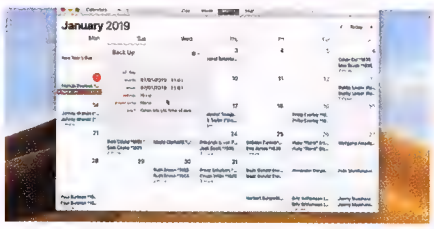
1 A CALENDAR WORKFLOW
Open up Automator and create a new Calendar workflow. This workflow is triggered by an automatically repeating event in your Mac's calendar – great for 'setting and forgetting'.



2 SELECT YOUR FILES
Add the 'Get Specified Finder Items' action to your Automator workflow and click the 'Add' button to select any files and folders that you want to automatically back up on your Mac.



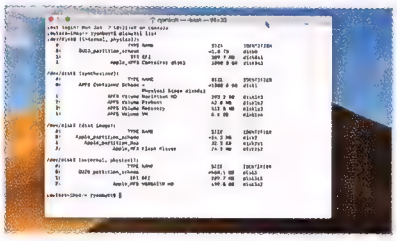
3 CREATE AN ARCHIVE
Add the 'Create Archive' action to your workflow, give your backup zip file a name and choose 'Dropbox' as the 'Where' option. Alternatively, choose an external hard drive.



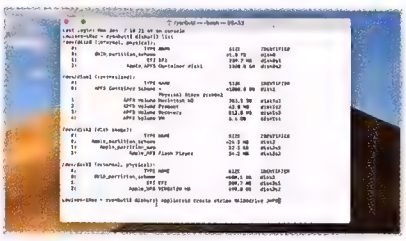
4 SAVE AND SET
Hit Cmd-S to save your workflow, give it a name and wait for Calendar to open. When it does, adjust the event with your workflow's name to choose when and how often it runs.

SET UP A RAID DRIVE

IF YOU WANT TO MAKE BIG BACKUPS HAPPEN FASTER, THE SOLUTION MIGHT BE TO SET UP A RAID 0 ARRAY WITH TWO HARD DRIVES THAT SPLITS THE DATA ACROSS THEM FOR FASTER WRITE SPEEDS.



1 LIST THE DISKS
You'll need to use Terminal. Fire it up and type 'diskutil list' to see the drives connected to your Mac. Note their identifiers.

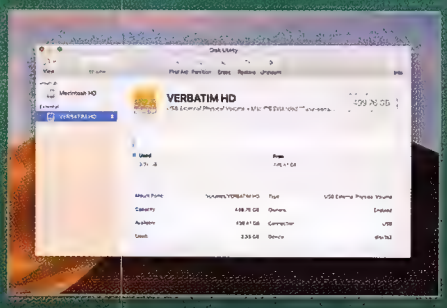


2 CREATE YOUR RAID
Note the identifiers next to the drives you want to use and type 'diskutil appleraid create stripe RAID0drive JHFS+ [first identifier] [second identifier]'.

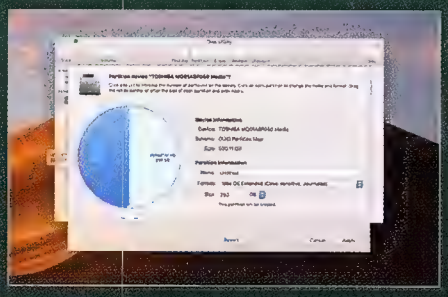
PARTITION A HARD DRIVE

ALTHOUGH IT'S BEST TO START A BACK UP WITH A BRAND NEW DRIVE, PARTITIONING OFF THE FREE SPACE ON AN OLD ONE (EFFECTIVELY CREATING A SECOND, VIRTUAL DRIVE) CAN BE A WORTHWHILE ALTERNATIVE.

1 OPEN DISK UTILITY
To partition a hard drive on your Mac you'll need to use a built-in app called Disk Utility. If you have never used it, the easiest way to locate it is through Spotlight.



2 SELECT YOUR DRIVE
Select the hard drive and ensure it has enough free space for the partition you want and then (ideally) back up its contents before you get started on the process.



3 SLICE THE PIE
Click on 'Partition' then click on the '+' icon to split up the pie representing the drive. Adjust the segment size and name to suit, then click 'Apply' button to start partitioning.

Create a hard drive clone

With Carbon Copy Cloner.

CARBON COPY CLONER

Carbon Copy Cloner isn't free, but it's good value. Download a free, 30-day trial from **www.bombich.com**. After that you'll need to buy it for $58.45.

THE FINAL DESTINATION

Your destination drive should be formatted macOS Extended (Journaled) and bigger than your Macintosh HD so it can be booted from if you need to in the future.

SELECT YOUR SOURCE

For a full clone of your Mac's hard drive, select Macintosh HD (unless yours is called something different) as your Source in Carbon Copy Cloner's Task Plan interface.

SET A SCHEDULE

For a fully bootable clone of your hard drive, we recommend setting it to be remade weekly or at least monthly so that you'll always have relatively recent data ready.

ALL THE FILES

Under the Source section you'll have the option to choose what you clone. As we want to be able to boot our Mac from this backup, ensure that 'All files' is set.

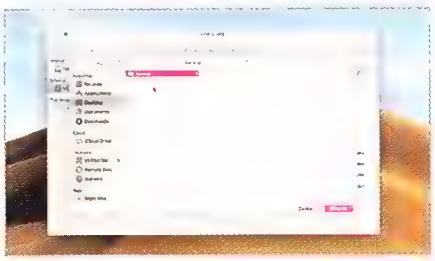
EMAIL THE ERRORS

Under the Email options, select 'Only send on errors' so you're alerted when your clone isn't correctly backed up and can fix the issue quickly, ready for the next backup.

USE DISK UTILITY TO CREATE A COMPRESSED DISK IMAGE

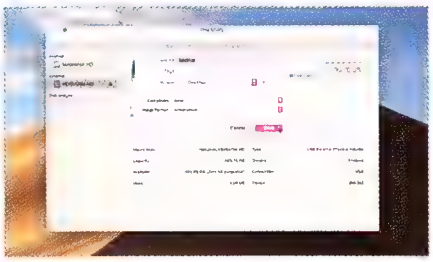
EASILY PRODUCE A PORTABLE COPY OF YOUR MOST IMPORTANT FILES.

Creating a compressed disk image might sound complicated, but essentially it involves creating a single file that contains a copy of any folder on your Mac's hard drive. For a one-off backup of your most important data it's a great option and entirely free.



1 SELECT FOLDERS OR FILES

Fire up Disk Utility, head to File > New Image > Image from Folder and select the files or folder you want to include in your compressed disk image. You might want to organise these into a single folder.



2 NAME AND CREATE

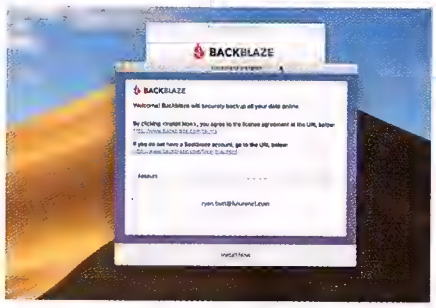
In the Save dialog that appears give your disk image a logical name, select where to save it to and ensure that the Image Format is set to 'Compressed'. When you're ready click 'Save'.

Create an online backup with Backblaze

Create an automatic, cloud-based backup to complete your setup.

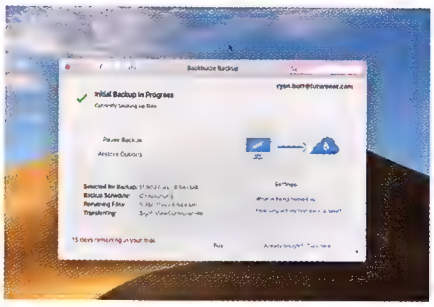
With a Time Machine backup running, you're halfway there to having the perfect Mac backup plan in place. Remember the rules though. Make it automatic and back up in at least two different locations. Using an online backup service means your data is copied to a remote location (often on a different continent) on a regular basis, so you'll always have a reliable backup to fall back on should you need it. There are a few options out there, such as CrashPlan and Livedrive, but we're big fans of Backblaze for its price and compatibility.

1 PICK A TEMPLATE
To get started, head to **www.backblaze.com** and sign up for a free 15-day trial. The service usually costs $50 per year, but this is a great way to kick the tyres.



2 NAVIGATE THE GRID
Signing up for the trial will start a download of the Backblaze installer. Run this and enter your administrator password when prompted so the app can access everything it needs.

3 HUNT IT DOWN
Once installed, Backblaze can be found as a pane under System Preferences. It's pretty lightweight and runs in the background, but there are a few options.



4 CHECK YOUR PROGRESS
In Backblaze's Preference pane you can check the progress of your backup (first one takes a while) and adjust additional settings, such as additional hard drives to back up.

BEST ONLINE STORAGE APPS

STORE SELECT FILES ONLINE FOR FREE FOR EXTRA PEACE OF MIND.

DROPBOX

Free (2GB) or $12.74 per month (1TB)
Dropbox's seamless integration with MacOS (and iOS) makes it incredibly easy to set up and use. Anything you add to your Dropbox folder is synced to the Dropbox website and to any other devices you own.

GOOGLE ONE

Free (15GB) or approx. US$9.99 per month (2TB)
As part of a recent revamp (it used to be called Google Drive) this service will provide double the amount of storage for paying customers as well as family plans, and it is very easy to use.

ONEDRIVE

Free (5GB) or $10 per month (1TB)
Microsoft's OneDrive is no different to Dropbox and Google One when it comes to file syncing, but the paid tier is slightly cheaper and does offer the full suite of Office365 apps (that's Word, Excel and PowerPoint).

AMAZON CLOUD DRIVE

Price depends on market
If you're an Amazon Prime customer ($6.99 per month) Amazon Cloud Drive gives you unlimited photo storage, plus 5GB of space for other files. If you're not an Amazon Prime customer or want additional storage space then the pricing varies.

ICLOUD DRIVE

Free (5GB) or $14.99 per month (2TB)
If you're looking for the ultimate in macOS and iOS compatibility, Apple's iCloud Drive is a great option. It has been integrated seamlessly into Apple's own apps and works across all devices.

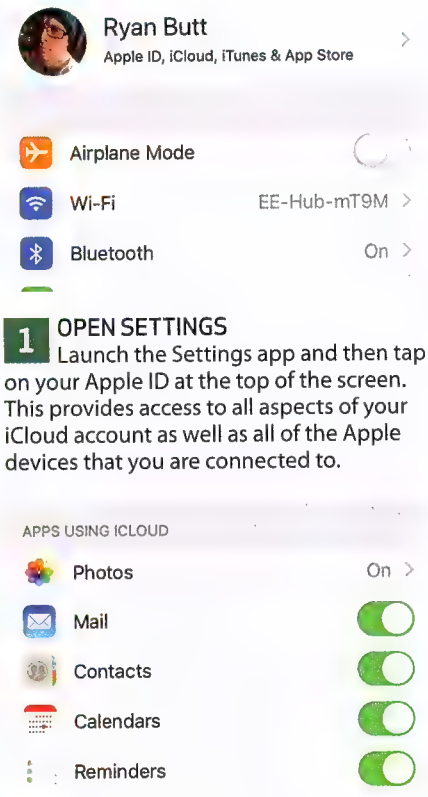
Back up your device to iCloud

Make the most of your iOS device's built-in system.

When it comes to backing up your iPhone or iPad, you've got it easy. Apple provides a solid, built-in system for backing up that works automatically and keeps a copy of the most important files on your iOS device safe in the cloud should the worst ever happen. With iCloud Photo Library, the photos you take are covered perfectly too. Although iCloud backups and iCloud Photo Library are very much 'set it and forget it' systems, we've covered that first below to help you get started.

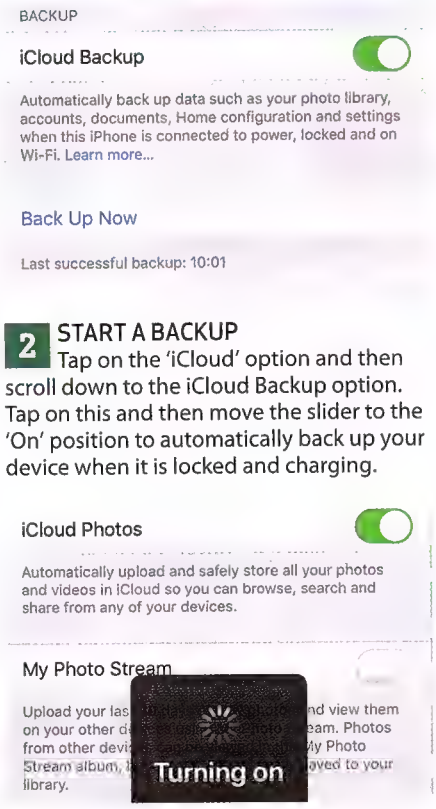
INCREASING ICLOUD STORAGE

iCloud storage is cheap, but you'll need more than your free quota if you're uploading your Camera Roll. We'd recommend starting with the 50GB tier.



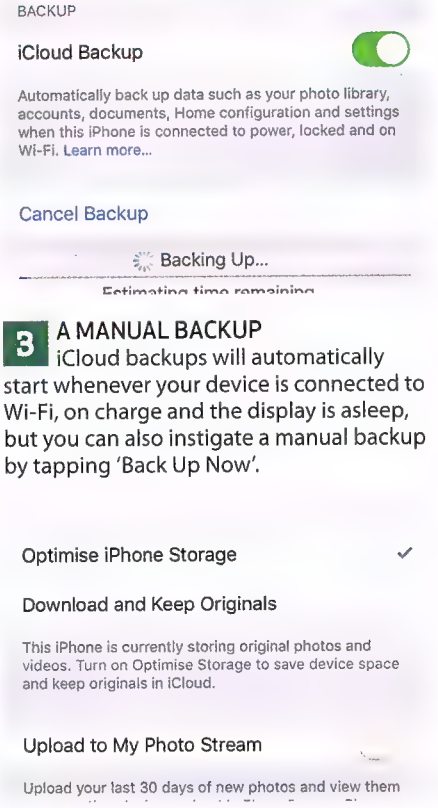
1 OPEN SETTINGS
Launch the Settings app and then tap on your Apple ID at the top of the screen. This provides access to all aspects of your iCloud account as well as all of the Apple devices that you are connected to.

4 SYNC YOUR PHOTOS
To enable iCloud Photos, stay in the Settings app and head to iCloud > Photos. Be aware that you may need to pay to upgrade your iCloud storage as part of this setup depending on the number of photos.



2 START A BACKUP
Tap on the 'iCloud' option and then scroll down to the iCloud Backup option. Tap on this and then move the slider to the 'On' position to automatically back up your device when it is locked and charging.

5 SWITCH IT ON
Flick the switch at the top marked 'iCloud Photos' to start syncing all of your photos and videos. Once that's up and running you'll see there are a few more options to work with.



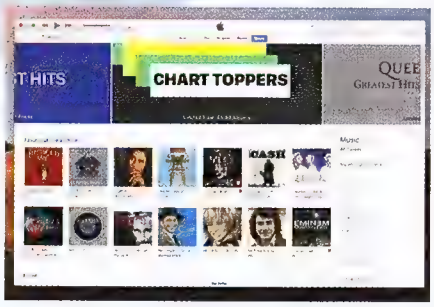
3 A MANUAL BACKUP
iCloud backups will automatically start whenever your device is connected to Wi-Fi, on charge and the display is asleep, but you can also instigate a manual backup by tapping 'Back Up Now'.

6 KEEP IT LIGHT
It's highly likely that your iPhone has far less storage than your Mac, so be sure to select the 'Optimise iPhone Storage' option to avoid any of those unwelcome 'iPhone full' warnings that can pop up.

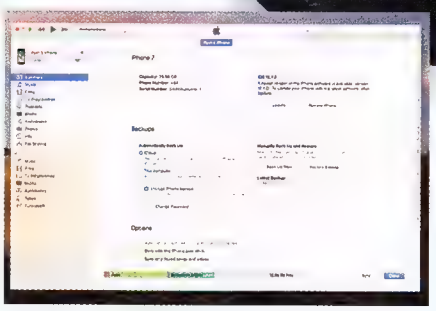
Back up with iTunes

Create an additional backup of your iOS devices using iTunes.

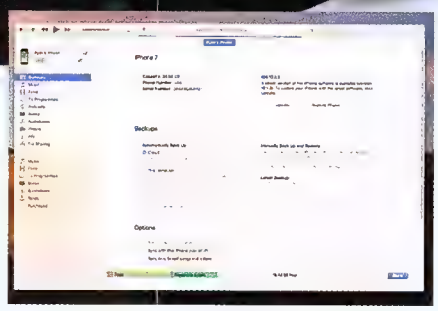
Although iCloud backups of your iOS devices can generally be relied upon, it never hurts to have a secondary backup in a different location. That's where iTunes comes in. If you're familiar with the world of iOS before iCloud, then backing up like this might be covering old ground, but if you've always relied on iCloud it's time to start backing up with iTunes. It's best to keep your iCloud backups running, but use the manual back up and restore options for iTunes. They'll need encrypting too if you want to save things like passwords and Health data. Let's go.



1 FIND YOUR IPHONE
Plug your iPhone or iPad into your Mac or PC and fire up iTunes. From here, find the small device icon in the top-left corner of the window. Clicking this will bring up your device's options in iTunes.



2 BACK UP NOW
In your device's iTunes Settings screen look down the right side and find the Manual Back Up and Restore settings (you'll find details of your last backup below that). When ready click the 'Back Up Now' button.



3 CANCEL THE BACKUP
If you have a change of heart or need to step away from your computer, it's easy to cancel the current backup; just click the 'X' icon at the top of the window. This will cancel the backup in progress.

ENCRYPT YOUR BACKUP IN ITUNES

ENSURE YOUR MOST SENSITIVE DATA IS BACKED UP AND SAFE.

When you perform a manual back up in iTunes for the first time you'll be asked whether you want to encrypt your data or not. This means that sensitive information, such as Health data and passwords, can be saved. If you decided not to encrypt there and then, don't worry; you can still enable this setting ready for next time.

1 TICK THE BOX
Under the Automatically Back Up options, find and click on the checkbox marked 'Encrypt iPhone Backup'. This won't affect current backups but will encrypt any in the future.

2 SET A PASSWORD
You'll be prompted to set a password, which you'll need if you restore from an encrypted iTunes backup. This can be anything you like, but try and choose something original.

25 of the BEST Windows 10 apps for 2019

LIFESTYLE & ENTERTAINMENT

We scoured the Microsoft Store to find the best apps that will improve the way you use your Windows 10 PC

Windows 10 has come a long way since its launch in July 2015, and for good reason. Microsoft described it as the first "operating system as a service" that would receive ongoing updates to its features and functionality, with the October 2018 Update extending its install base to over 500 million active devices, or 40 percent of all PCs.

The October 2018 Update brought enhancements like a desktop 'dark mode', a new and improved Notes app and a revamped Clipboard. These features generally make life easier when it comes to using Windows, but at some point you'll probably need to look elsewhere for an app that performs a particular function not covered by Windows 10. And that's where third-party apps come in. Thanks to the Microsoft Store, additional apps are just a couple of clicks away – and many of them are free to download. Even those that do have a price ask for just a few pounds, which is a far cry from traditional boxed software, and you can be sure of their quality, too, since the Store is a hand-picked collection curated by Microsoft itself

So read on and discover what our top picks are from the Microsoft Store for 2019 and beyond.

1 Zen: Coloring Book for Adults

Free • JH Digital Solutions

Colouring books aren't just for kids, as this app proves. Zen: Coloring Book for Adults is designed to help the older folks relax and unwind in a creative and stress-free way. The 40 designs included in the book are more intricate and involved than you'd find in a children's colouring collection, and the tools include pencil shading, brush size and a darkness meter. You can also undo strokes, share images, and zoom with ease.

2 Netflix

Free • Netflix

Netflix has become a staple of the TV series binge-watching generation, and for good reason – it's the Internet's top digital TV and film service by a mile. With the Netflix app you can instantly watch as many TV episodes and movies as you want, and there's plenty of quality original content to choose from. You can search for titles and watch them immediately on your Windows 10 devices. There's a free trial for a month included, and then it's $9.99 per month.

1

3 Spotify

Free • Spotify AB

Spotify is the world's most popular streaming music service. Its costs $11.99 per month, ad-free, with the option to download music and enjoy it offline. Or you can plump for the ad-supported version, which enables you to enjoy the music without paying. You can also access any local music files on your PC through Spotify's intuitive interface, which lets you create playlists of your favourite genres, tracks and artists.

4 Amazon

Free • Amazon.com

If you love shopping online with Amazon then forget accessing the website through a browser – use this app instead. It enables you to make purchases, search departments, compare prices, read reviews, create wishlists, and share product and gift ideas with friends using a simple, elegant interface. You can access any of Amazon's sites around the world using the app, simply by choosing your desired regional store.

5 Plex

Free • Plex

Plex is a media streaming server that enables you to organise your video, music and photo libraries and access them on your devices using a beautiful interface. Your media will never have looked so good, because Plex imports rich descriptions, artwork, trailers, and other related information to augment the specific content of your collection. With a premium Plex Pass subscription, you can sync videos, music and photos to smartphones and tablets to enjoy offline, and even share your media with family and friends.

6

VLC

Free • VideoLAN

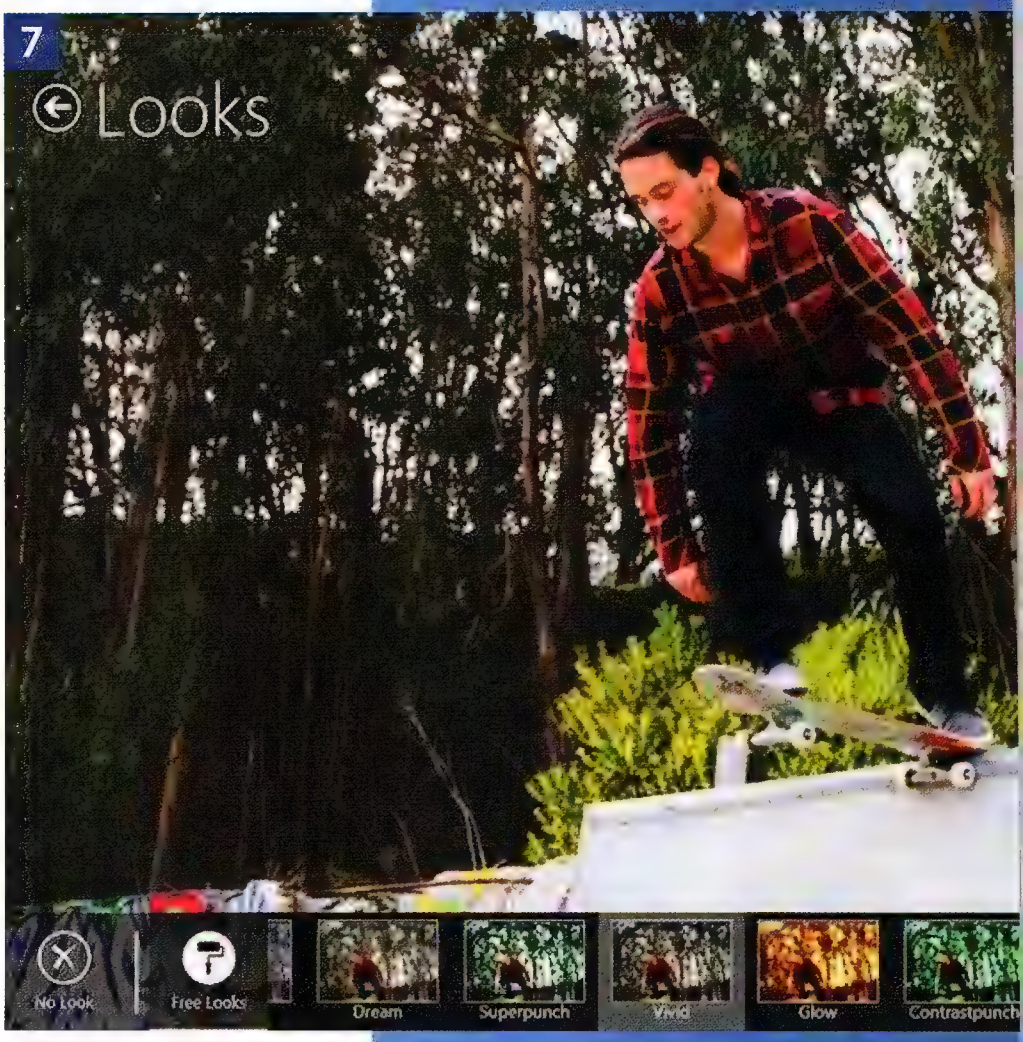
VLC has held the crown as the most versatile media player for years now, and for good reason. It plays nice with countless video and audio file formats, and also includes a media library for all your files, complete with metadata fetching. It's also had a refresh for Windows 10, so the look and feel matches Microsoft's operating system, while updates to its codec, library and search features keeps it just as relevant as it was when it came on the scene over 18 years ago.

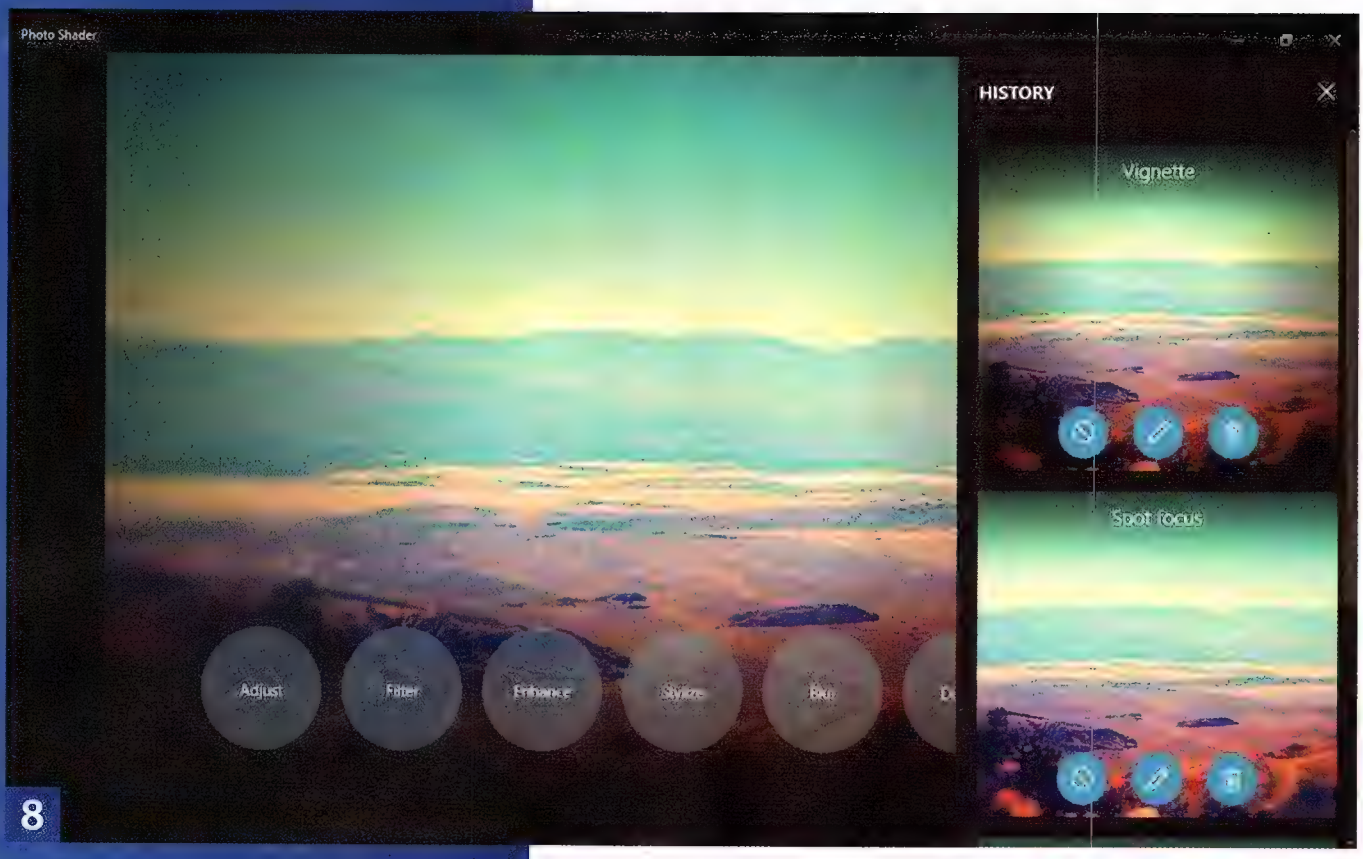
7

Photoshop Express

Free • Adobe

Photoshop has become a household name thanks to the unrivalled power of the professional editing suite, but if your image manipulation needs are more modest, you might want to check out Photoshop Express. With one-click features such as Auto-Fix to adjust brightness, exposure and shadows in snaps, and slider controls for exposure, contrast, clarity and vibrance, it's no wonder Adobe's free app remains one of the most popular photo editing options in the Microsoft Store. You can even add to its toolkit with in-app purchases.





8

8

Photo Shader

Free • Ryken Studio

Photo Shader is another long-standing resident of the Microsoft Store, largely thanks to its host of easy-to-use editing tools and effects filters, not to mention an excellent editing history feature that allows you to revisit any changes you've made to your images. Photo Shader also has a slick interface, which presents its tools as a series of buttons that scroll across the screen, making it even easier for you to perform quick edits to your photos and then save the end result.

9

Polarr

Free • Polarr

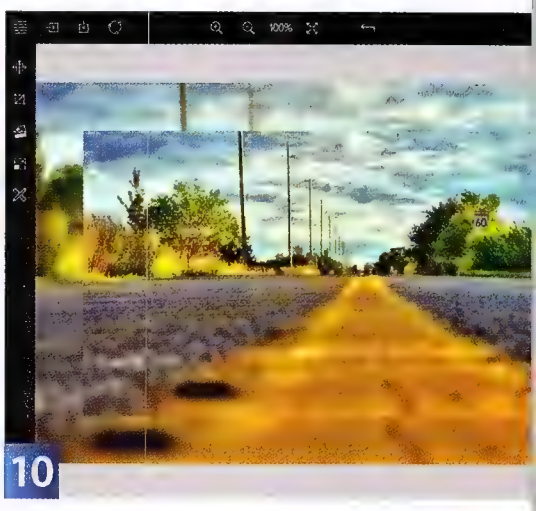
Polarr is a powerful, and free, photo editor that uses Artificial Intelligence techniques to help enhance the look of your photos. It comes with a vast range of easy-to-use tools, and is available in two different guises: Express, which is ideal for touch-based devices; and Pro, which dispenses with the labels on app icons giving you more room to work with. And if you like the app, paying for a subscription ($3.49 a month or $34.99 per year) gets you even more tools, including a wider selection of overlays and masks.

10

Fhotoroom

Free • Supporting Computers

If you enjoy sharing your photos with the rest of the world or are looking for a quick-fire way to get your snaps out to friends and family as soon as they're edited, consider Fhotoroom. The app is host to a burgeoning community of like-minded snappers, but that's not all. It also packs a raft of editing tools, from the basic (exposure, contrast, cropping, etc) to professional-quality tools such as HDR conversion, tilt shift, colour splash, filter brush and more. It even offers support for 150 image formats.



10

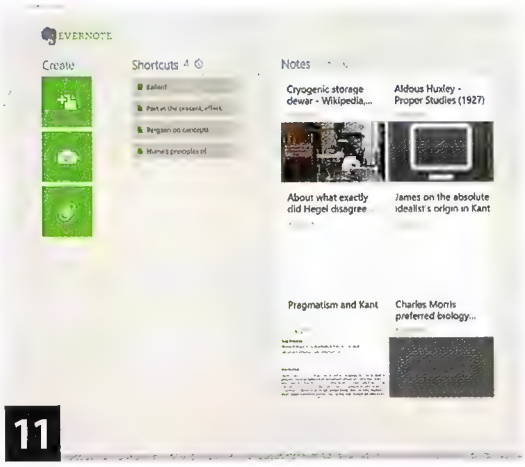
PRODUCTIVITY

11

Evernote

Free • Evernote

Evernote is like a digital filing cabinet for your notes. Each note has a title, an input field for adding tags, a date and location, and an editing window into which you can drag files or type into. When you type, a style and formatting bar appears, with options to create numbered, bulleted and check lists, insert tables, record audio, and share a note. You can also add a reminder if the note needs actioning later. Best of all, your notes sync to the cloud.



12

Microsoft To-Do

Free • Microsoft

To-Do is very easy to use – create a master list of tasks, with deadlines, then choose which you want to complete today. The current day's tasks will appear under 'My day', and can be set to disappear once they're marked as complete. To-Do is simpler than a tool like Trello, which lets you assign work to different people and hold conversations about jobs, but that's by design – To-Do is for more everyday tasks. That said, you can share your list with others, so it's handy for divvying up family tasks.

13

Plumbago

Free • Microsoft Research

Microsoft's Plumbago – Latin for graphite – is a note-taking app designed specifically for people who love handwriting and drawing, with technology that smooths out the strokes when using a stylus like the Surface Pen on a Surface tablet. It makes use of realistic ink technology and other user-friendly features, such as an optimised tool picker designed to reduce the number of taps to access its options.

14

Microsoft Office Online

Free • Microsoft

Free office suites are hard to come by in the Microsoft Store (understandably, since Microsoft is keen to push Office 365 subscriptions). Office Online is less well known than Google Docs, but is impressive and offers native support for Microsoft document formats. All documents are saved to OneDrive, so you can access them from any device with an Internet connection. The Office Online app simply adds an icon to your Edge toolbar that gives you quick access to Microsoft's web-based versions of Word, Excel and PowerPoint.

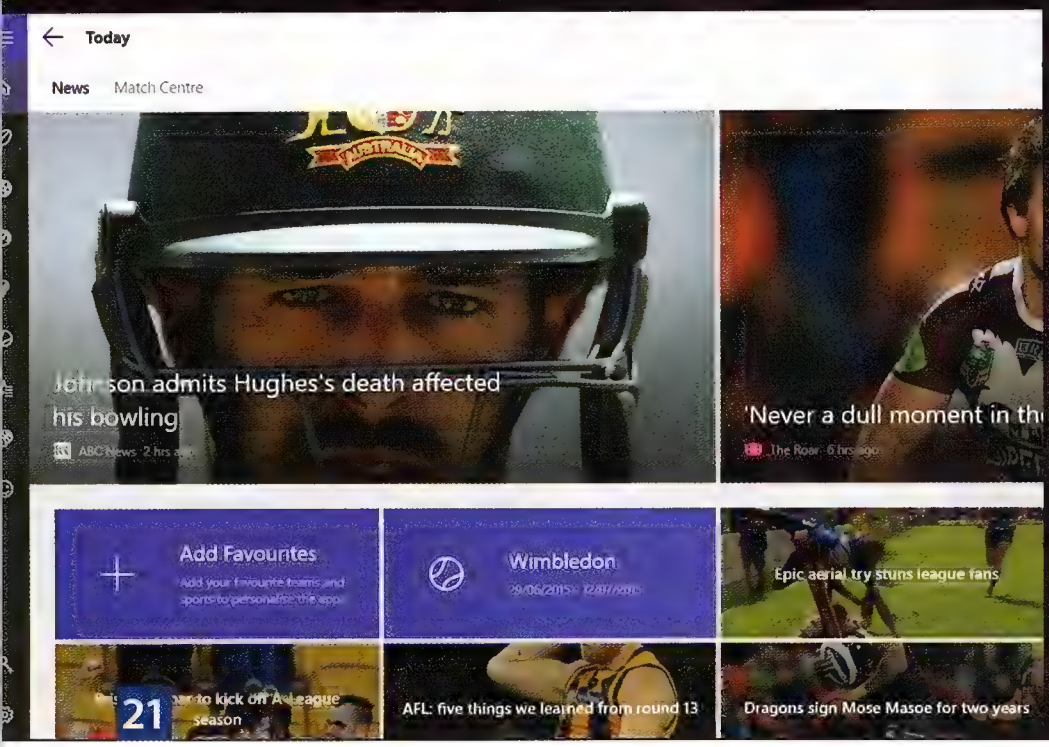
15

Wunderlist

Free • 6 Wunderkinder

This surprisingly versatile and easy-to-use app has proved so popular with users that Microsoft bought the German company that came up with it in 2015. Like Taskify, Wunderlist helps you create and curate all kinds of to-do lists, sync them across mobile and other devices, and even share them with others – perfect then for delegating jobs to co-workers and domestic chores to other members of your household. Wunderlist looks beautiful, too.

NEWS & SPORT



21

MSN Sports

Free • Microsoft

If you're looking for one sports app to rule them all, you won't go wrong with MSN Sports. It offers worldwide 24/7 coverage of a bewildering array of sports, including live scores, results and rankings as well as video highlights. The app is fully customisable, too, so you only need to see news from the sports, teams and events that you're particularly interested in.

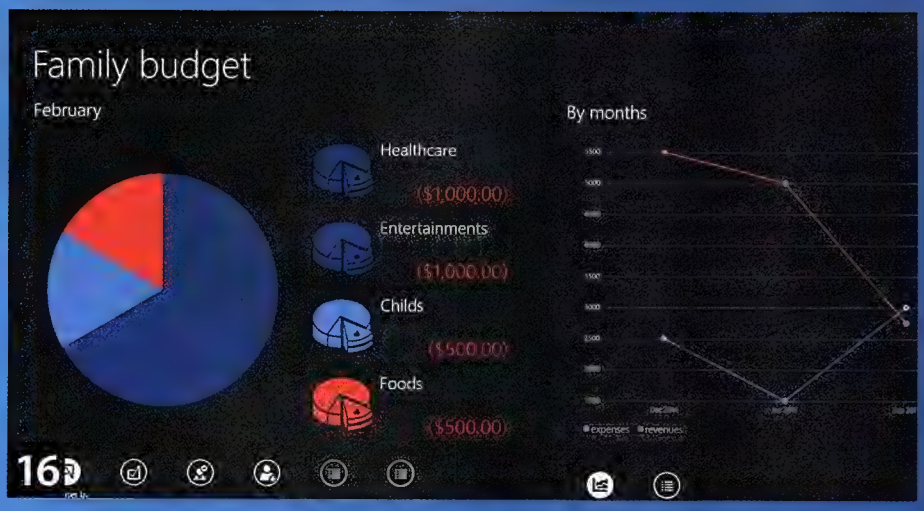
22

Flipboard

Free • Flipboard

Flipboard is like your own newspaper, daily curated content served straight to your home screen in an easily navigable, readable magazine format. It's not just full of text, either. Articles are rich with video and imagery from some of the most iconic sources in newspaper journalism. Magazines can be built around any topic, and the app supports sharing options such as Twitter and Facebook.

HOME & FINANCE



FamilyBudget

Free • Geo HOG

FamilyBudget takes some of the boredom out of home financing by making your data more aesthetically pleasing, but without sacrificing on useful features. It lets you view expenses and income history by month, category and individual family members. What's more, you can track your family's overall budget, store your data safely in the cloud and get access to it whenever and wherever you need it. You can also recover data in case of disaster, so you'll always know how much the kids are costing you.

17

HotSpot Shield Free VPN

Free • AnchorFree

This is one of the few VPN options available in the Microsoft Store – but it's also one of the most trusted. When you first launch the app, you'll be prompted to either pay for a premium subscription or start a seven-day free trial, but if you tap the back arrow (top left), you can proceed to use the free VPN. Note, though, that the free version's 500MB daily limit isn't much use for streaming.

18

Spending Tracker

Free • MH Riley

Spending Tracker is another free app that helps you keep abreast of where your money is going and where it's coming from, and aims to make it easier for you to identify areas of expense so you can cost-cut and increase your regular savings. The tabbed interface lets check the health of your finances in weekly, monthly and annual timeframes, and you can also set a budget total to stick to, while a useful overview of your spending progress is just a click away.

19

Simplenote

Free • Automattic

This free, minimalist and elegant app makes it easy to create any kind of note, list or to-do – and then share it seamlessly across all your devices, with any changes you make backed up automatically, so you can always revert to a previous version should the need arise. What's more, Simplenote offers Markdown support, as well as tags (making it easy to find content later). You can also share your notes and lists with others and even publish them online.

20

MoneyPoint

Free • Two Square Systems

MoneyPoint helps the budget-conscious record, categorise, track and tick off all their daily transactions in a simple accounting format. You can maintain schedules and payees between separate accounts within the app, and if you're wary of the cloud, don't worry – MoneyPoint stores all your data locally and secures it with a password. Additionally, you can schedule reminders to pay upcoming bills and outgoing payments.

23

Save to Pocket

Free • Read It Later

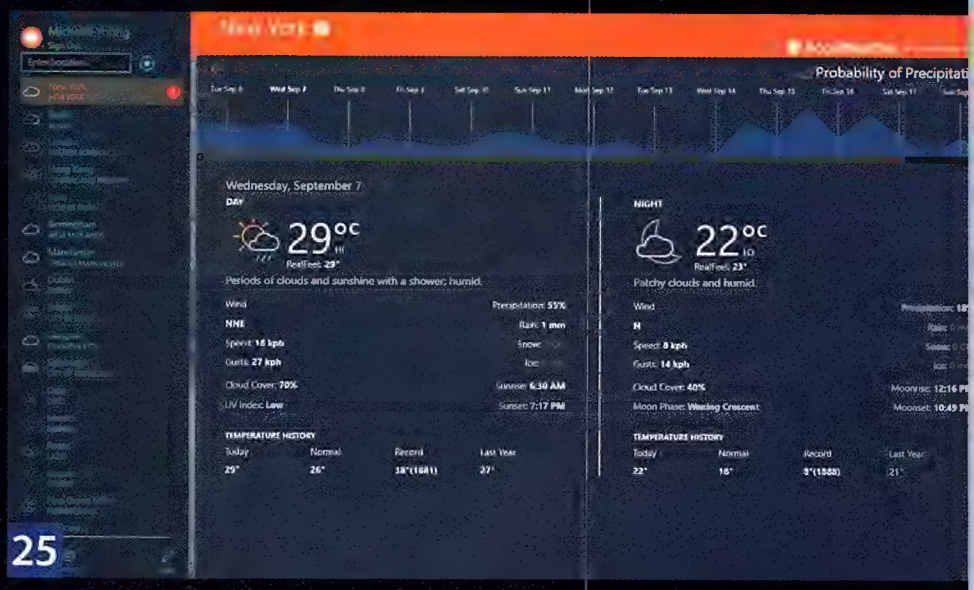
Save to Pocket is an extension for Edge, which lets you save the contents of any web page so you can read it later on any device – including your PC. It's ideal for everything from news stories to recipes and even gives you the option to have the contents read out loud. The app presents items you've saved in a clutter-free layout and can offer personal story recommendations, tailored to your interests.

24

Readiy

Free • Nishro Tech

If you prefer to have stories delivered using Really Simple Syndication (RSS) news feeds, then Readiy is your go-to app. It makes subscribing and updating your feeds super-easy and presents them in a slick, customisable interface that marks items as read as you scroll. The app is free for you to download and use, although you gain additional features and get to banish adverts by paying for the Pro version via In-App Purchase (IAP).



AccuWeather

Free • AccuWeather

AccuWeather serves up some of the best radar maps, local forecasts and weather updates available on Windows 10, or anywhere. Using the snazzy app and live tiles you can stay up to speed on what's going on outside of the window, with localised minute-by-minute forecast updates based on your address or GPS location. Plus, interactive maps, weather videos and Cortana integration. We also love its new automatic theme, which seamlessly switches its look based on sunrise/sunset times where you are. Brilliant.

TOP 100 LINUX TOOLS

Take a stroll through the open source garden as we pick the best apps, tools and utilities available to all Linux kind...

We all have our favourite open source apps that work for us better than any available alternative. But take a moment and step back from the Emacs vs vim type battles raging on in the Linux-verse and marvel at the sheer number of apps at our disposal. Your distros' software repositories give you access to thousands of apps, and you can install everything from fully featured app suites to nifty command-line utilities literally with the touch of a button.

There are open source apps and tools for all kinds of applications today. There's hardly any use case that isn't catered for by a community contributed app. Many of these apps have proved their mettle and offer features and performance benefits that surpass their proprietary counterparts. They have also proved themselves to be invaluable to home and business users in more than one sense of the word. According to rough estimates on **www.openhub.net**, some popular apps such as LibreOffice, Firefox and Apache would take several hundred person-years to develop and cost millions of dollars. Yet they are all available to you for no cost.

Open source apps come in many shapes and sizes and you can grade them based on their usability. There are feature-rich apps, task-oriented app suites, well put-together tools, and newfangled novelty apps and games. Some ship with well-designed graphical interfaces and others show their more versatile sides when operated from the command-line.

In this feature, we traverse this diverse and vast collection of open source gems on offer and pick the ones that are at the top of their game. In this list of the 100 best apps we've covered a wide range of categories. Whether you are a business owner, an educational institution, a developer, a home user, or a gamer, we've got something for everyone. While you'll be familiar with some of the most popular tools in this list, rest assured there are quite a few that might have missed your attention. If you've been unable to escape the clutches of commercial software, we're sure you'll find quite a few tools on this list that are suitable replacements.

Essential apps

A Linux desktop isn't complete without them!

LIBREOFFICE

Forked from OpenOffice.org, LibreOffice has become one of the most popular office productivity suites. It includes programs for word processing, and can create spreadsheets, slide shows, diagrams and drawings, maintain databases, and compose mathematical formulae. It also offers good compatibility with documents in proprietary formats and has recently had a face lift.

www.libreoffice.org

THUNDERBIRD

Another gem from the Mozilla Foundation, Thunderbird is one of the best email clients, being easy to setup and is brimming with features. Simple setup wizards aid syncing with popular web-based email services and it can manage multiple accounts, supports encryption and is extended through add-ons.

www.mozilla.org/thunderbird

GUFW

You may not be using a firewall currently, and that's because they are difficult to set up than you need to be. It features an intuitive graphical interface for managing the inbound and outbound traffic. All rules are stored and are well-suited for transparent use.

www.gufw.org

Gufw has profiles and preconfigured rules to aid inexperienced users.

WINE

Despite the increasing number of cross-platform apps that work on Linux, there are some that stubbornly support Windows. This includes big third-party proprietary apps, such as Adobe Photoshop or just small or home-grown tools that you can't do without. For such situations, you can use Wine, which generally runs these Windows-only apps and games with ease. The project supports over 20,000 apps. Some work flawlessly out-of-the-box, others require minor configuration tweaks.

www.winehq.org

KeepassX

Trying to remember different passwords for the various services is a challenge for most humans (that don't count cards in Las Vegas for fun). You can defer this task to KeePassX which stores password in an encrypted database. It can fill in the password automatically and also includes a random password generator.

www.keepassx.org

VIRTUALBOX

When Wine doesn't cut it you can use VirtualBox to run an entire Windows installation inside a virtual machine. The software is also useful for installing experimental apps that you don't want to deploy on a real computer, and for testing other OSes without exposing it to real hardware.

www.virtualbox.org

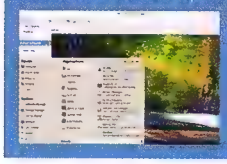
BLEACHBIT

A distro accumulates a lot of digital gunk over time. BleachBit helps you spring clean it and protect your privacy. It also removes temporary and other unnecessary files, and has tools to securely delete files or wipe them.

http://bleachbit.sourceforge.net

REMMINA

With Remmina you can access a remote computer from the comforts of your desktop. It supports the widest range of protocols and will connect to all kinds of remote desktop servers. The app is easy to use, and has enough features that make it a viable option for occasional use.



http://remmina.sourceforge.net

OPENSSH

When you need to interface with a remote computer, you cannot do without OpenSSH. It's a family of tools that provides secure networking capabilities by encrypting all traffic, and includes several authentication methods, and supports all SSH protocols.

www.openssh.org

CLONEZILLA

This is a cloning solution that's distributed as a live CD and is popular for doing bare metal backup and restoration of individual PCs. It can also deploy an image to multiple computers in a lab. Clonezilla can work with a large number of popular disks, partitions and filesystem types.

www.clonezilla.org

VLC

Distros ship with a functional video player. But if you need more control, there's no beating VLC. It supports virtually every video and audio format out there and includes handy CLI tools for advanced users.

www.videolan.org/vlc

PEAZIP

PeaZip is a graphical archiving tool that can work with over 130 different types of archive files and can even create encrypted ones. It integrates with popular desktops and also has a CLI for advanced users.

http://bit.ly/PeaZipSF

GPARTED

Use Gparted to restructure a disk on your computer. It's available as a live CD and can also be installed inside your distro. Gparted can create, resize, move, delete, reformat or check partitions and supports many filesystems.

www.gparted.org

ZULUCRYPT

Create an encrypted disk within a file or within a non-system partition or USB disk. ZuluCrypt has an intuitive user interface and can be used to encrypt individual files with GPG.

http://bit.ly/zuluCrypt

HOMEBANK

This is a feature-rich finance app. It can import data from other apps and bank statements in popular formats. It can also detect duplicate transactions and features dynamic reports and is easy to use for budgeting.

http://homebank.free.fr

Internet apps

Get the best of the web with these tools.

FIREFOX

One of the most widely recognised pieces of open source software, Mozilla's Firefox web browser is the default browser on virtually every Linux distro. It's pretty responsive and known for its privacy features. You can customise it to the hilt and also extend it with an impressive number of extensions.
www.firefox.com

RSSOWL

An excellent desktop alternative to Google Reader, RSSOwl is a new aggregator for RSS and Atom News feeds that's easy to configure. The app gathers, organises, updates, and stores news in an easy to use, and saves selected items for offline viewing and sharing.
www.rssowl.org

MIDORI

The go-to browser for anyone concerned about resource consumption, Midori is popular with lightweight distros. Despite its lightweight nature and design, Midori has all the features you'd expect from a web browser including a speed dial, tabbed interface, bookmark management and configurable web search as well as an incognito mode.
www.midori-browser.org

GFTP

The gFTP client is a feature-rich client that'll get the job done, if you need to download files via FTP occasionally. It has a simple two-pane interface that shows the content of the local and remote filesystem. Using gFTP you can also transfer files between two remote servers.
http://gftp.seul.org

FILEZILLA

For those who use FTP a lot, there's FileZilla. The client supports FTP, SFTP and FTPS protocols and has just about any configuration option you can imagine. It also has a tabbed interface so you can browse more than one server and even transfer files simultaneously between multiple servers.
https://filezilla-project.org

TOX

Privacy-conscious users should try the new decentralised IM and VoIP client called Tox. This relies on a distributed network, which uses P2P connections, the same technology used by BitTorrent to provide a direct connection between users for chats and, unlike other Skype alternatives, Tox uses no centralised servers or supernodes, which could be compromised. All chats are also encrypted using the peer-audited NaCl crypto library.
https://tox.im

JITSI

Jitsi is the best VoIP app, as long as you're not averse to Java apps. It supports IM and make one-to-one audio and video calls, as well as audio conference calls. It supports many of the widely used IM and telephony protocols, including SIP, XMPP, AIM, ICQ, MSN, etc. Jitsi has all the features you'd expect from a softphone, and more, such as encrypt text chats with OTR and voice and video by establishing a ZRTP session.
https://jitsi.org

DELUGE

BitTorrent is popular for downloading Linux distros and there are numerous download clients. One of the best is Deluge which has multiple front-ends, including a graphical and a web-interface. It has features that enable advanced users to tweak it to their liking and also has a nice library of plugins.
www.deluge-torrent.org

ARIA2

What makes Aria2 a unique utility is that it can download the same file at the same time using different protocols. The lightweight CLI app can download via HTTP, FTP, BitTorrent and Metalink and can also open multiple connections to download the file faster.
http://aria2.sourceforge.net

PIDGIN

Pidgin is a wonderful app for instant messaging over many network protocols. You can sign in with multiple accounts in the single client and chat with many friends in different networks. You can use it to connect to AIM, MSN, Google Talk, Yahoo, Jabber, IRC and more chat networks all at once.
www.pidgin.im

Media

0 A.D.

This is a real-time civilisation-building strategy game that features impressive graphics and intense battle gameplay. It's yet to have a final release but has already won accolades in its current state.
http://play0ad.com

FREECIV

A strategy game that challenges players to lead their tribe from 4,000 BCE to the space age.
www.freeciv.org

ALIEN ARENA

A popular first person shooter with a sci-fi theme and the tournament style deathmatch of *Quake* and *Unreal Tournament*. The game has several game modes and over 60 maps, and is quite configurable.
http://red.planetarena.org

OPENMW

OpenMW is a new game engine that recreates the popular *Morrowind* RPG. The aim of the project isn't to improve game assets or add additional features but to provide gamers a more moddable edition of the game.
https://openmw.org

FLIGHTGEAR

For fans of aircraft simulators there's *FlightGear* that aims to offer flight across real world terrain. It includes scenery for more than 20,000 airports, and can be extended with your own aircraft and locations.
www.flightgear.org

Office and productivity

Enhance your workflow with these apps.

CALLIGRA

Unless you feel you need LibreOffice's superior compatibility with proprietary formats, you may want to consider Calligra. It's a continuation of KOffice and unlike LibreOffice, Calligra has a modern-looking, modular design, and also uses Open Document as its native file format. It ships with a large church of apps. In addition to the Words word processor, Tables for spreadsheets, Stage for preparing presentations, and Kexi for managing databases, it also benefits from Krita for digital painting.
www.calligra.org

ZATHURA

This is a simple and a lightweight PDF reader that supports almost all the usual features you'd expect. You can search text strings, jump pages, zoom in and out, rotate pages, add bookmarks and more. In addition to PDFs, it can display DjVu and even encrypted documents.
https://pwmt.org/projects/zathura

GNUMERIC

AbiWord is usually paired with the lightweight Gnumeric spreadsheet app. However, the application lights on features and offers a lot more functionality than proprietary spreadsheet apps. Gnumeric will import data from Microsoft Excel files and there are import filters for other apps as well.
www.gnumeric.org

ABIWORD

The wide gap between rich text editors and word processors is occupied by AbiWord. It's lightweight but still offers commonly-used word processing features, which makes it a popular for lightweight distros. It also offers cloud-based collaboration capabilities via its AbiCollab.net service.
www.abiword.org

KMYMONEY

Designed for KDE users, KMyMoney is a feature-rich accounting app. It supports different account types, such as Cash, Checking, Savings, etc and can categorise incomes and expenses, and can reconcile bank accounts. If your bank allows it, you can have KMyMoney connect to your bank directly to retrieve your account activity.
https://kmymoney.org

GNUCASH

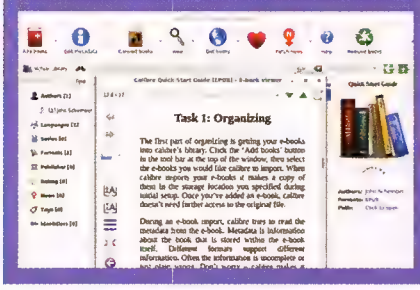
Gnome users have GnuCash which is similar to KMyMoney in terms of features, but also handles and categorises entries differently. GnuCash is a personal and small business accounting app that's based on double entry for professional reporting and besides dealing with monetary transactions, it can track things such as stocks, bonds and mutual funds.
www.gnucash.org

PROJECTLIBRE

A project management tool helps you stay on top of complex projects and ProjectLibre is one of the best. It's an open source app that's used widely by many enterprises around the world. ProjectLibre has several useful features and can also interface with various clients and issues.
www.projectlibre.org

CALIBRE

You can use Calibre to manage your collection of ebooks, and supports a wide range of readers and smartphones. The app can import ebooks manually or, if you prefer, by syncing a reading device such as the Kindle. Any files imported can be sorted and grouped by metadata fields, which can be pulled from various online sources, such as
www.goodreads.com
www.calibre-ebook.com



XOURNAL

This app is very handy for when you need to scribble bits of information down for later. As well as typing out notes, you can use it with either a mouse or a stylus. It can also be used to add annotations to PDF files.
http://xournal.sourceforge.net

OPENLDAP

OpenLDAP is great for when you want to run a directory server. It implements the LDAP protocol and has all the expected features, including logging, replication, access control, user and group management etc. It also integrates with Active Directory.
www.openldap.org

ACHIEVO

This is a web-based resource management tool with a simple interface for accessing its CRM, HRM and project management and planning tools. You can also track resources across multiple projects.
www.achievo.org

OKULAR

The default PDF viewer for KDE and includes a good number of useful features. Besides PDF it can also read a number of other file types, including Postscript, DjVu, CHM, XPS, ePub, TIFF, CBR and others.
https://okular.kde.org

LATEX

LaTex is a document preparation system and document markup language based on TeX. Its purpose is to simplify TeX typesetting for documents containing mathematical formulae and is widely used in academia.
www.latex-project.org

SHUTTER

Besides capturing the full screen, Shutter can capture a specific area, or a window. You can also upload to a hosting service.
www.shutter-project.org

CLAMAV

While most viruses and trojans will have no effect on Linux, you still can have infected files in your distro that can wreck havoc when accessed on a Windows machine. So be a good admin and use ClamAV to scan files.
www.clamav.net

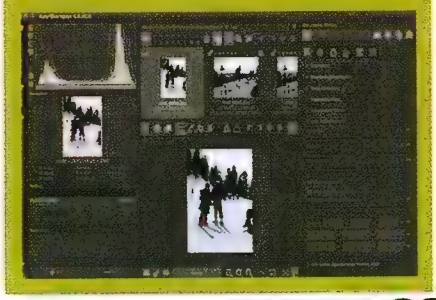
Hobbyist

Follow your passion!

RAWTHERAPEE

Do you shoot with a digital single lens reflex camera (DSLR)? Then take a look at RawTherapee, which includes a wide range of tools for processing and converting RAW files. In addition to basic manipulations, the app has extensive options for working with RAW files. Using the app you can adjust the colour and brightness values of your images, correct white balance, adjust tones, and a lot more. Besides RAW files, you can also use RawTherapee for editing traditional image files, and also includes Adobe Lens Correction profiles.

www.rawtherapee.com



SCRIBUS

An intuitive desktop publishing program, Scribus can be used to create professional pieces ready for online or print distribution. It supports multiple pages, boxes and objects. It has a vector-rich interface and has features such as PostScript colour separations, support for CMYK and spot colours, ICC profiles and prints marks. Scribus also includes a variety of templates and styles, and you also get a variety of settings and tools to precisely define and position the various layout elements you require.

www.scribus.net

KRITA

Although Krita is part of the Calligra suite it needs a special mention of its own. Krita is a digital painting and illustration app that offers many expressive brushes, HDR painting, filters, perspective grids, painting assistants, and many other features you'd expect from such an app.

www.krita.org

STELLARIUM

Stellarium is a free open source planetarium for your computer. It calculates the positions of the Sun and Moon, planets and stars, and draws the sky as per the users location and time. It can also draw the constellations and simulate astronomical phenomena such as meteor showers, and eclipses.

www.stellarium.org

JOSM

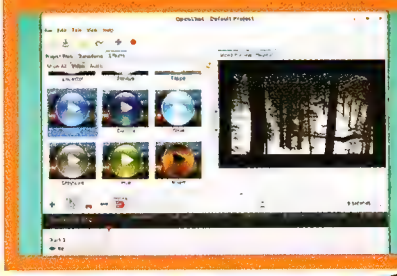
Keen to contribute to the mapping project, OpenStreetMap? Then use JOSM. It's a Java-based offline map editor that can help you plot GPS traces. You can load GPS track-logs into JOSM and start adding streets to OpenStreetMap instantly. Although OpenStreetMap has several other editors available, most contributors use JOSM for their edits, as it lets them upload changes back to OSM quickly and easily enough. JOSM offers several features and can be extended with plugins and styles.

https://josm.openstreetmap.de

OPENSHOT

There are only a handful of video editors for Linux and OpenShot offers the best combination of features and ease of use for the home user. You can use it to combine videos, audio tracks and still images together and add captions, transitions, and more, and export the final product in a variety of formats. OpenShot can also use Blender to create 3D animated titles.

www.openshot.org



INKSCAPE

Another pro-quality tool, Inkscape offers advanced vector graphics editing and is popular for drawing vector art, line art, and designing logos and graphics. It's brimming with features, such as markers, clones, alpha blending and more, and is often compared to expensive proprietary apps such as Illustrator and CorelDraw.

www.inkscape.org

CINELERRA

Cinelerra is excellent if you need to edit more than home videos, as it's the most advanced non-linear video editor and compositor for Linux. It supports hi-fi video and audio and is resolution and frame-rate independent, which enables it to edit videos of any size. The app has several advanced features, such as overlays, denoising, normalisation, time stretching, color balance, compositing, real time effects and a lot more. It also includes a compositing engine for performing tasks such as keying.

www.cinelerra.org

Media

COMIX

Digital comics are distributed as comic book archive files that mainly consist of a series of image files, typically PNG or JPEG files, stored as a single archive file. Comix can read digital comics in virtually every format.

http://bit.ly/ComixApp

FONTFORGE

FontForge is a feature-rich app for creating and editing fonts and supports all common font formats. It can extract information from a font file as well as convert from one format to another, and can be used for previews.

http://bit.ly/FontForge

CAIRODOCK

CairoDock is a MacOS X dock-like app. One of its main advantages over other docks is that it doesn't require a compositing window manager to work and can add bling to older low powered machines.

www.glx-dock.org

AUDACITY

If you need to work with audio, you should use the powerful Audacity sound editor. You can trim audio, combine tracks, and even stack multiple tracks, as well as export to a number of formats and quality settings.

http://bit.ly/AudacityApp

MPD

The Music Player Daemon is an audio player with a server-client architecture, which means you can control it remotely from another computer. It plays audio files, organises playlists and can maintain a music database.

www.musicpd.org

Development

Power tools and programs for power users.

JEDIT

This is a text editor for programmers that supports auto indent, and syntax highlighting for more than 140 different programming languages. The app enables you to define complex macros and offers a powerful and user-friendly keyboard mapping system. It's highly configurable and customisable, and you can extend its functionality by adding plugins.
www.jedit.org

ECLIPSE

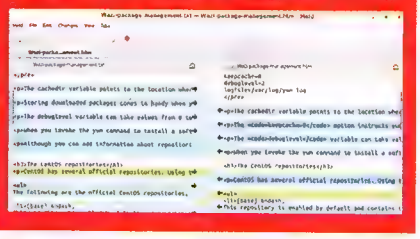
There's no beating Eclipse, the most feature-rich IDE. Although Java is its speciality, Eclipse supports a range of languages via plugins. In fact, its plugin marketplace is an indispensable resource. Eclipse does code refactoring and you can use it to extract the selection as a local variable or method. Since it can target multi-person installs, it handles version control very maturely.
www.eclipse.org

BLUEFISH

Do you develop for the web? Bluefish is a multi-language editor that's designed for web developers. It supports many programming and markup languages and focuses on dynamic and interactive websites. It supports code block folding, unlimited undo/redo, automatic tag closing, and syntax highlighting. Another useful feature is the snippets bar from where you can add the most common snippets of code for a variety of languages. Bluefish also has support for popular open source web apps such as MediaWiki and Wordpress.
http://bluefish.openoffice.nl

MELD

A graphical diff tool, Meld enables you to compare two or three files as well as whole directories. It includes features, such as syntax highlighting and direct file editing, and using the tool you can easily isolate and merge the differences. Meld can also be used to browse various popular version control systems such as CVS and Subversion.
www.meldmerge.org



KOMPOZER

New and experienced HTML programmers will save a lot of amount of time and effort with this Kompozer editor. It has an intuitive interface and includes a colour picker, an FTP site manager, CSS editor, customisable toolbars, forms, spell checker, markup cleaner and can use validate code using W3C's HTML validator.
www.kompozer.net

GIMP

Despite its name, Gimp is a powerful, comprehensive image manipulation program. It offers a wide range of tools for professional-quality photo retouching and image manipulation capabilities for free. It also offers a huge list of features and supports all the common graphics file formats.
www.gimp.org

BLENDER

With Blender, animators can create 3D printed models, visual effects, art, interactive 3D applications and video games. The app provides a wide range of features that can be used to create 3D animation films. It's a one-stop 3D package and includes a gaming engine, a video sequence editor, production-ready camera and object tracking, a large library of extensions, and an advanced physics engine. It can render fluid dynamics and simulate the movement of elastic objects and clothes.
www.blender.org

GEANY

You don't need a full-blown IDE if you only program occasionally, which makes Geany a good choice. It's a cross between a plain text editor and an IDE with support for the popular languages and nifty features like a compile/run button, a listing of functions defined in the currently opened file, and much more.
www.geany.org

APTONCD

Suddenly realised that you need to move your Ubuntu installation or need to give a friend a copy of your setup? With APTonCD Ubuntu users can back up all of their installed packages to an ISO image, which can then be added as a software source on another installation. You can use this source to restore the packages on to the system or keep everything in the APT cache.
aptoncd.sourceforge.net

CLEMENTINE

Use Clementine to play locally stored music and streaming audio. The app has an attractive interface and it also helps organise and transfer music to various devices, and integrates well with popular cloud services.
www.clementine-player.org

ICECAST

With Icecast you can stream music across the network. *Icecast* supports many audio streams simultaneously and listeners can access a stream via a remote media player and also configure MPD as a source.
www.icecast.org

AMAROK

If you use KDE your distro may already include this music player, Amarok. It too integrates with several online audio services, and its features include creating dynamic playlists, bookmarks, scripting, context view.
https://amarok.kde.org

LMMS

LMMS is digital audio workstation that produces music by synthesising sounds, arranging samples, and playing them on a MIDI keyboard. It also has a song editor and plugins to simulate instruments and effects.
www.lmms.io

KODI

Until recently Kodi was known as XBMC. It's an excellent option for users who wish to turn their PCs into media hubs. It plays most kinds of media files and works with TVs, IR and bluetooth remote controls.
www.kodi.tv

Utilities

Apps that let you do more with your computer.

GNOME TWEAK TOOL

[illegible] with the Gnome desktop? Use the Gnome Tweak Tool to [illegible] the appearance settings of the desktop. With this tool, you can also change the behaviour of the Windows and Workspaces, manage extensions and you can even customise the design (depending on Gnome 3) by placing icons, files and folders on the Gnome desktop.
http://bit.ly/GnomeTweakTool

GRUB CUSTOMIZER

Grub 2 is the most popular Linux bootloader that is used by virtually all major distributions. It is an impressive piece of software with lots of options. The Grub Customizer is a simple to use graphical tool which enables you to quickly customise all aspects the bootloader, including its appearance.
www.launchpad.net/grub-customizer

HANDBRAKE

When the need to convert a video arises, Handbrake, the video transcoder app does a commendable job. It can convert nearly any format and supports a wide range of video codecs. One of its best features is built-in device profiles for popular devices that make the conversion process easier.
www.handbrake.fr

EASYSTROKE

Want to control your PC with the flick of the mouse? The EasyStroke app lets you define and manage gestures by recording the movements of your pointing device while holding down a specific mouse button. You can then configure actions that'll be executed when the app recognises the defined stroke.
https://easystroke.sourceforge.net

DOSBOX

Relive the good ol' days with DOSBox and play your favourite classic DOS games that won't run on your modern hardware. This is an x86 PC emulator that creates an IBM PC compatible computer complete with compatible graphics and sound cards. The app can also simulate networking hardware for multiplayer games on the local network and even over the internet. The Wine project even uses code from DOSBox to bolster support for DOS apps.
www.dosbox.com

DIGIKAM

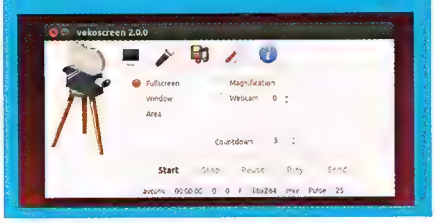
One of the best photo management tools for Linux is digiKam and it has features that'll appeal to all kinds of users. It recognises all major image file formats and can organise and sort images based on metadata. The app also has plugins to export images to various online services.
www.digikam.org

AVIDEMUX

Avidemux is a video editor and converter that can be used for basic cutting, filtering and encoding tasks. It supports many file types, including AVI, MPEG and MP4. The app is designed for users who know what they want to do but also provides an intuitive interface so that tasks such as cutting and appending videos are pretty straightforward. The app has some presets and users can also save custom settings that make the app easier for new users to operate.
http://fixounet.free.fr/avidemux

VOKOSCREEN

A feature-rich screencasting app worthy of note is Vokoscreen, which is based on FFmpeg for handling multimedia data. Vokoscreen can capture both video and audio, with options to record the entire screen, window or a selected region, along with video from a webcam. The app supports MPEG4, x264, MP3 and Vorbis codecs and can save files in either .AVI and .MKV containers. The app offers some controls such as the ability to change the video quality and frames captured per second and can be used to make screencasts of games.
www.kohaupt-online.de/hp



K3B

Although it's designed for KDE, the K3b optical media burning utility is one of the finest for the job. The app can burn multiple El Torito boot images, audio CDs, VCDs, SVCDs, mixed-mode CDs, eMovix CDs, and DVDs. It can also rip DVDs and write ISO images.
www.k3b.org

Terminal

NCMPCPP

This is a command-line MPD client that's easy to use and customisable. It provides useful features such as the ability to sort playlists, song lyrics, item filtering, fetching artist's info from last.fm, tag editor and much more.
http://bit.ly/Ncmpcpp

SAMBA

Samba is a suite of programs that enables Linux users to access and use files, printers and other commonly shared resources on a Windows PC on a network and does this by supporting the SMB protocol.
www.samba.org

RTORRENT

Here we have a command-line BitTorrent client with an ncurses interface. You can run it as a daemon and manage it with *screen* and since it supports SSH you can manage your torrents from any remote machine.
http://bit.ly/rTorrent

LINKS2

There are lightweight browsers and then there's Links2. This is a web browser that can render complex pages and even has a pull-down menu. It's also special because it's a CLI browser that you operate via the keyboard.
http://links.twibright.com

MIDNIGHT COMMANDER

Before the days of graphical file managers, real hackers used Midnight Commander, known as *mc*. It's still your best option if you regularly find yourself in the console environment a lot.
http://bit.ly/MidnightCdr

Admin tools

Take charge of your distro with these power apps.

REDO BACKUP

We've mentioned the Clonezilla cloning solution earlier in the feature, but if all you need is a tool to swap out an old disk for a new one, then you use Redo Backup and Recovery. The tool is designed for inexperienced users and has the simplest of interfaces.

www.redobackup.org

XAMPP

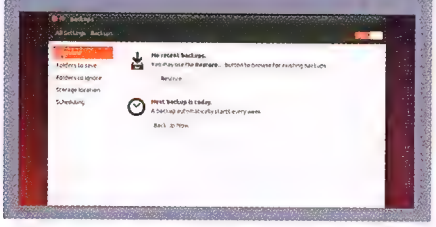
The XAMPP stack gives you a single package that you can use as a sandbox to test and develop web apps. It includes all the necessary components such as Apache, MySQL, PHP, and Perl as well as several other libraries, modules and tools, such as phpMyAdmin and FileZilla for managing the stack components. Once installed, you can manage the various services via a graphical control panel.

www.apachefriends.org

DEJA DUP

The app's minimal GUI sets itself apart from the various other backup apps you'll find, and it lets you configure backups within a matter of minutes. Deja Dup is based on Duplicity and provides just the right number of features for desktop users who aren't used to the ways of a backup tool.

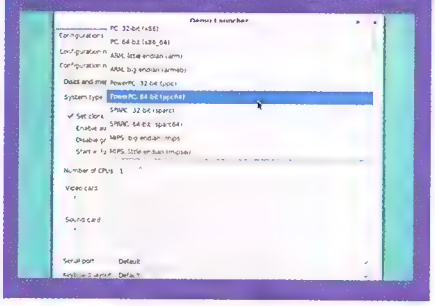
http://live.gnome.org/DejaDup



QEMU

It's is a feature-rich multi-purpose processor emulator and virtualiser. You can use it to create virtual machines and even emulate various hardware architectures. If you have the right hardware on tap (a processor with hardware virtualisation extensions), you can use Qemu with KVM in order to run virtual machines at near-native speed.

www.qemu.org



MONDO RESCUE

Mondo is a unique backup solution that creates bootable backup and restoration disks customised for the system being used. Mondo has a text-driven interface and works with a wide range of file systems and can use a variety of media as backup medium.

www.mondorescue.org

OPEN MEDIA VAULT

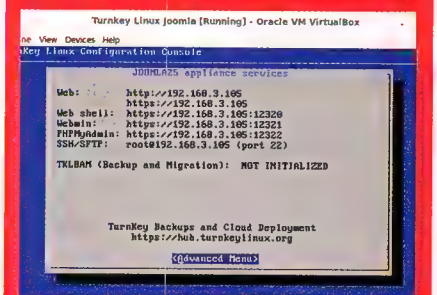
When you need more compression for your data than a simple backup then you need to deploy a NAS server. The OpenMediaVault project is a Debian-based server that offers the power of commercial options in a very nas's easy-to-setup and manage.

www.openmediavault.org

TURNKEY LINUX

The Turnkey project produces appliances which you can use to deploy a new server in a jiffy. A Turnkey appliance is a self-contained system that packs in a fully functional web app that runs on top of Just enough Operating System (JeOS) components required to power that particular app. All the appliances are based on Debian but are available in several formats depending on the hardware that you want to deploy it on. Once they're up and running you can manage each appliance using a browser-based interface.

www.turnkeylinux.org



ZENTYAL

The Zentyal distro has all the components you need to run a gateway server. The distro simplifies the process of setting up, monitoring and controlling the components of the server with a host of custom management tools and helps you configure the servers without mucking about with config files.

www.zentyal.org

MUTT

Mutt is to email what Links2 is to the web browser. It's a text-based mail client that is highly configurable and it supports both POP and IMAP protocols and has all the usual features you'd want from an email client.

www.mutt.org

PROFANITY

Profanity is a console based client for the XMPP protocol that supports multi-user chats and OTR message encryption.

www.profanity.im

CANTO

Want to do more from the command-line? Get the Canto CLI RSS feed reader. It supports RSS, Atom and RDF feeds and imports and exports feeds in OPML format. It has lots of customisation and even configure it with Python.

http://bit.ly/CantoRSS

MPG123

This is an MP3 audio player for the command-line that supports gapless playback. It's so good that its decoding library, libmpg123 is used by other audio players for MP3 playback.

www.mpg123.de

FFMEG

One of the most versatile media conversion utilities, FFmeg can manipulate virtually any type of media file in various ways, such as changing bitrate, extract audio, record streams, extract stream and much more.

www.ffmpeg.org

System News

Mark Williams will miss his 16:10 muse, though his new 21:9 does have some nice curves.

Aspect ratio – it's not really something you think about every day, yet will likely deal with on a subconscious level. Smartphones are where this usually happens. Say you're browsing your favourite social feed and you come across a trailer for a new movie that has just released, you click play and when switching to full screen you automatically rotate your phone to get the wider aspect ratio to best view the content.

Having the correct aspect ratio for the task at hand can make all the difference. Unfortunately, with PCs and their big bulky monitors, one can't simply rotate them around willy-nilly to suit the content you're looking at. So, getting the right size and ratio when it comes to purchase time is important.

I recently upgraded from a 30-inch 16:10 monitor to a 34-inch 21:9 curved monitor. Despite the larger screen size, the first thing I noticed was the shorter height. As someone who uses Word and Photoshop regularly, this missing height does affect how efficient one's workflow is. It also effects how much of web pages you can see at any given moment as webpages are always long on the y-axis.

16:10 is pretty much the perfect aspect for those who need to get work done. Wide enough to tile two windows beside each other yet tall enough for better viewing of documents and websites. I also found it nice when watching movies or YouTube as the extra height allowed the video to still take the full width of the screen, yet left the top and bottom of the screen available to show browser tabs above and the windows taskbar below, making for easy multitasking.

Unfortunately, 16:10 ratio screens are getting harder and harder to find. Jaimie from Leader Computers said "[16:10] is definitely dying off, mostly due to the cost of production". This is despite 16:10 still taking 8% of his sales, compared to 90% for 16:9 and just 2% for 21:9.

21:9 could however become the next big aspect ratio. Gamers are usually at the leading edge of adoption, and at the gamer focused Aftershock PC boutique, David told us that ultra-wide is their highest selling single monitor resolution and, as for aspect ratio, 21:9 already commands 36% of their sales compared to 63% for their 16:9 offerings.

21:9 has its own benefits of course; in terms of productivity, it's great for Excel sheets that use many columns, Word likes to show four pages beside each other instead of two (1080p) or three (1440p), and many movies are released now in the 21:9 aspect ratio, making it perfect for watching those at full screen.

Then there's the games. Having that extra peripheral vision in FPS titles or racing games really does afford you an advantage. Some games have trouble with this wide of a viewport but, for the most part, it's well supported.

Of course, nothing beats having more resolution. 4K, despite its 16:9 aspect, simply has so many pixels on offer I've found it great at work for productivity. Often tiling not just two windows, but four (each effectively 1080p each) for superior work efficiencies.

Whatever your need when buying a monitor, consider the resolution and aspect ratio to suit your needs. It'll make a world of difference.

SHOP TALK

What proportion of the monitors that you sell are ultra-wide screens? How popular do you think this aspect ratio will become?

Jaimie Ianson, Leader Computers:
"We see approximately 2% going to the ultra-wide format while the vast majority is still 16:9 and a smaller batch of 16:10 ratio screens.

There are definitely usage models for the ultra-wides, with business users seeking to declutter desks, run huge spreadsheets and other applications with large screen real estate demands and the like.

The gaming community is starting to adopt the format too, but the screens themselves can be quite cost prohibitive."

David Hwang, Aftershock PC:
"We expect the 1440p ultra-wide screens to become even more popular in the future. Right now, the gaming market is still in a bit of a transitioning period, where a lot of players still prefer their 1920x1080 setups. There is, however, a lot of traction being gained for 1440p ultra-wides with more powerful PCs being able to support the higher resolution monitors. We definitely expect the ultra-wides and 21:9 aspect ratio monitors to skyrocket in terms of popularity in the future."

Market Snapshot

A sampling of PC systems available this month.

JW Computers GMR Viper

$1,349 - TINYURL.COM/APC466-JW

Looking for a respectable entry level gaming PC? Like most PCs in this price range it has 8GB of RAM which, for 1080p game play and light multitasking, is enough for most situations.

The graphics card is a nice choice too, particularly with the 6GB framebuffer, so expect to be able to run games at high detail settings.

The CPU is an interesting choice — a quad-core APU. Given the discrete GPU already included in the system it's a wonder that an extra $15 wasn't charged to move this up to the hex-core R5 2600 instead.

The 400W generic PSU is something to be wary of if planning future upgrades.

KEY SPECS: CPU: AMD Ryzen 5 2400G , Cooler: OEM, Motherboard: A320M AM4 based, Graphics: GeForce GTX 1060 6GB, Memory: 8GB DDR4 2666Mhz, Storage: 250GB M.2 SSD, Power Supply: InWin 400W, Case: InWin EM058.

Aftershock PC Ultracore

$2,650 - TINYURL.COM/APC466-AFT

For those serious about gaming, this price range is where you start. The GTX 2080 inside is the second-best GPU available on the market currently and paired with the 8600K it makes for a very nice sweet spot machine, the bang-for-your-buck score is high on this one.

The CPU isn't the beefiest around, but if you like running your games at 1440p/4K with all the details cranked up for the shiny effects, you won't notice much of an impact on fps at all.

8GB of RAM is this system's only negative. The 16GB option at checkout for +$119 will be worth it long term.

KEY SPECS: CPU: Intel Core i5-8600K, Cooler: OEM, Motherboard: Z370 Chipset based, Graphics: Nvidia GeForce RTX 2080 8GB, Memory: 8GB DDR4 2666MHz, Storage: 256GB M.2 (SATA) SSD, TOSHIBA 1TB HDD, Power Supply: 850W Superflower or FSP brand, Case: Aftershock Tempered Glass Elite O11D Edition.

TI Computers Gaming 9700K

$2,490 - TINYURL.COM/APC466-TI

This system goes in a slightly different direction to the Aftershock PC. Where that one is GPU heavy, this system is CPU heavy. Meaning if you want to play titles with a high 140+ frame rate, this system could be better suited. However, due to the lower specced GTX 2070 included, 1440p should be your matching monitors target resolution as 4K would be a bit of an ask.

The aftermarket cooler should provide some handy latitude if overclocking is your shtick. This system appears to be a well-rounded option otherwise with the rest of the specs being quite solid.

KEY SPECS: CPU: Intel i7-9700K, Cooler: Cooler Master Hyper 212, Motherboard: Asus TUF Z390-Plus Gaming WIFI, Graphics: Asus GeForce RTX 2070 8GB, Memory: 16GB Kingston 2400MHz DDR4, Storage: 256GB M.2 SSD, 2TB Seagate HDD, Power Supply: Cooler Master 700W, Case: Cooler Master CM593.

Storm Computers SC Athlon 3.2GHz with Vega 3 Graphics

$669 - TINYURL.COM/APC466-ST

AMD's latest entry level CPU is leveraged in this super cheap system, taking advantage of Intel's price rises of late to offer something so cheap. As is always, there are sacrifices made. While the RAM and mass storage are very reasonable for this price, the most important part of this system, the APU, is its weakest link.

It includes just a dual core processor, it thankfully has SMT giving it four threads that only clock to a lacklustre 3.2GHz. These low specs will be the limiter in any heavy processing task.

So long as your expectations are tempered by this fact, this should be a nice cheap system for basic computing tasks.

KEY SPECS: CPU: AMD Athlon 200GE, Cooler: OEM, Motherboard: Asus Prime A320M-K, Graphics: Radeon Vega 3 (onboard), Memory: 8GB Crucial DDR4 2400MHz, Storage: Crucial BX500 240GB SSD, Power Supply: 420W, Case: Gigabyte GZ-MA01.

PC blueprints

The *APC* team's picks for a part-by-part perfect PC build to suit your budget.

PARTS LIST

PART		PRICE
CASE	BITFENIX NOVA TG	$69
PSU	450W CORSAIR CX450	$69
MOBO	ASROCK AB350M-HDV NEW	$99
CPU	AMD RYZEN 5 2600	$259
GPU	GIGABYTE GEFORCE GTX 1060 3GB	$299
RAM	8GB (2X 4GB) TEAM T-FORCE DARK 3000MHZ	$109
SSD	120GB ADATA ULTIMATE SU650 2.5-INCH SSD NEW	$39
HDD	1TB WD BLUE WD10EZEX	$59
OS	UBUNTU DESKTOP LINUX 18.04 LTS 64-BIT	$0
APPROXIMATE PRICE:		$1,002

Well, that's impressive: we managed to shave a total of $19 off the final cost of this build, and swapped out two major components at the same time. That's surprising because, given Nvidia's latest release, we expected the GTX 1060 to either hit EOL stock limits, and in turn shoot up, or the prices to shift regardless. But, no, it actually reduced. So, time to swap? Well, we've gone for a better spec motherboard this time around, ditching the no-longer-available AB320 ASRock mobo for an AB350M instead. It's a slightly higher specced chipset, with slightly better connectivity, and it only cost us $21 extra. So no hardships there, then. We saved $40 on the GPU, which helped negate the new swap-outs as well. We went for a 120GB ADATA SSD this time, the SU650 – none of that QLC nonsense – along with the carry-over WD Blue 1TB hard drive.

PARTS LIST

PART		PRICE
CASE	FRACTAL DESIGN MESHIFY C	$129
PSU	550W EVGA SUPERNOVA 550 G3 80+ GOLD NEW	$145
MOBO	ASUS ROG STRIX B450-F GAMING	$209
CPU	AMD RYZEN 7 2700	$369
COOLER	CORSAIR HYDRO H100I PRO 240MM RGB AIO	$169
GPU	ZOTAC GAMING GEFORCE RTX 2060 6GB NEW	$599
RAM	16GB (2X 8GB) TEAM T-FORCE @3000MHZ	$209
SSD	250GB SAMSUNG 970 EVO M.2 PCIE SSD	$135
HDD	1TB WD BLUE WD10EZEX	$359
OS	WINDOWS 10 HOME 64-BIT OEM	$140
APPROXIMATE PRICE:		$2,463

It really annoys us when GPU prices skyrocket – PTSD from the cryptocurrency boom, no doubt. But, seriously, the Asus GTX 1070 we used last issue (because 1070 Ti prices had started to skyrocket) is now $190 more than before. We wonder why that might be... So, begrudgingly, we've picked up the Zotac's GeForce RTX 2060 6GB instead. Slightly less memory than last issue's card, but on a par with the 1070 Ti GPU from the issue prior, at least in terms of performance – unless you like pretty puddles in *Battlefield*, of course (here's hoping some more ray-tracing titles come soon). Fortunately, pricing hasn't fluctuated too much elsewhere. We did lose out on the GPU – $60 more, purely down to the fact it was one of the cheapest dual-fan RTX 2060s we could find – but we managed to knock $10 off the PSU price by upgrading to the G3 edition of the 550W EVGA PSU, as opposed to the G2.

UPGRADE OF THE MONTH

Nvidia GeForce RTX 2060

$600, WWW.NVIDIA.COM

Yes, we spent time in the last issue moaning about it, but still recommend it as "Upgrade of the Month." It's difficult to compete with this right now — the fact you can find it for less than $600 makes it impeccable value for money. It's a very strong 1440p gaming card, and with the added bonus of DLSS and potentially some ray-tracing elements in the future, it has a strong footing for the days to come.

Unlike its top-heavy brethren, we've yet to hear of anything going wrong with these cards with regard to memory burn-out either (although it is early days), so hopefully there should be far fewer RMAs than we saw with the first gen.

> "So, yes, this rig is definitely open to interpretation, and that's the inherent beauty of PC building, after all."

Oh sweet, sweet savings. Sometimes, it's difficult to keep this build where it's at. And because, at the low end, every dollar is far more valuable with regard to where you place it, at the high end, you can do so many different things with that amount of cash that, more often than not, a "jack of all trades" build like this is very easy to criticise. For a hardcore gamer, for instance, you'd probably drop Threadripper and go for a Core i9-9900K; for a streamer, you'd potentially keep it as is, or go for an Intel Core i9-7900X; for a 3D CAD person, you'd throw out that 2950X, and go for a 2990WX instead, with a lot more memory. Need a high-end server or NAS? Throw out the processor and mobo entirely, and opt for a Ryzen platform, along with a shedload of hard drives. You get the idea.

So, yes, this rig is definitely open to interpretation, and that's the inherent beauty of PC building, after all. For us, though, this is a nice, versatile system — 16 cores and 32 threads are still holding strong, and will do so for some time. If the rumours of the Ryzen 3000 series are true, then we may be looking at 16-core versions of that soon enough. However, it still won't come with all of those PCIe lanes, or quad-channel memory. And PCIe 4.0? Well, we currently don't have the tech to even scrape on that just yet, and the hardware that will won't be that dissimilar from the specs here, so you'll still be happy, even two to three years down the line.

PARTS LIST

PART		PRICE
CASE	NZXT H700I	$170
PSU	CORSAIR RM750X WHITE 750W GOLD CERTIFIED	$199
MOBO	ASROCK X399 PHANTOM GAMING 6	$285
CPU	AMD THREADRIPPER 2950X	$1,415
COOLER	NOCTUA NH-U14S TR4-SP3 AIR TOWER	$105
GPU	MSI GEFORCE RTX 2080 VENTUS 8G **NEW**	$1,222
RAM	32GB (4X 8GB) TEAM T-FORCE DDR4 @ 3000MHZ	$389
SSD	512GB SAMSUNG 970 PRO M.2 NVME	$229
HDD	2X 2TB SEAGATE BARRACUDA ST2000DM008	$89
OS	WINDOWS 10 HOME 64-BIT OEM	$140
APPROXIMATE PRICE		$4,243

A PC build for a buddy

A $3,000 budget, and a potent gaming PC upgrade for a friend in need.

A friend of ours approached us at the end of last year with a question. His rig was getting dated, his Core i5-4690K quad-core processor wasn't as punchy as he'd like, and although he had a fairly solid GPU (a GTX 1070), he wanted to know what we'd recommend he do with a roughly $3,000 budget. Cue a quick trip to PCPartPicker, and a few select questions.

The first thing we always ask people who throw that particular query at us is: "What are you interested in doing with your rig?" It's a very open-ended question, but it makes a lot of sense to ask, because there's no perfect solution that'll answer every problem in the world of computing. Sure, a $25,000 hyper-rig might be able to game well, compute advanced neural nets, or simulate your fantasy football league with ease, but if you only want to play *World of Warcraft* at 1440p, spending your money on a 28-core Xeon processor and 2.5TB of ECC memory is not going to be a good investment, no matter how you spin it.

Our friend's answer was fairly simple: *WoW* at 1440p, and AAA gaming on the side. He's already got the screen setup, plus the GPU, so all that was left for us to do was work on the infrastructure – the storage, processor, motherboard, cooling, and, more importantly, the case – and give the whole thing enough gumption to last 4 to 5 years, without feeling sluggish once more.

"He wanted to know what we'd recommend he do with a $3,000 budget. Cue a few select questions."

PARTS GALORE

So, where do we begin with that budget? First things first: processor and motherboard. Because our mate's mantra is gaming, we've gone with an Intel Core i7-8700K. We chose it for a number of reasons. The big clock speeds and single-core performance should help quite dramatically in game – six cores and 12 threads are plenty for what he has in mind – and despite the fact that it doesn't have a soldered IHS, temperatures are roughly the same as its eight-cored i9-9900K sibling. It's also much cheaper than the latter part, which is good news for us, because it's more important that we spend that cash elsewhere.

Speaking of which, the motherboard we've picked is the latest Z390-i ROG Strix Gaming from Asus. This little ITX juggernaut is packed with all the staple ITX features we've come to love from the Taiwanese company, with impeccable audio, integrated M.2 heatsinks, and a whole splurging of I/O on the rear.

Memory-wise, we originally bought a kit of 32GB (2x 16GB) Corsair Vengeance LED DDR4, which, although more than adequate for this rig, unfortunately conflicted with our liquid cooler, because it was too tall. So, we swapped it out for the G.Skill Trident Z kit we already had in stock (included in the "Ingredients" list on the right).

On top of all that, we're packing the whole lot inside an NZXT H200i small form factor chassis, along with a Kraken X52 240mm AIO, and an M.2 PCIe SSD.

PARTS LIST

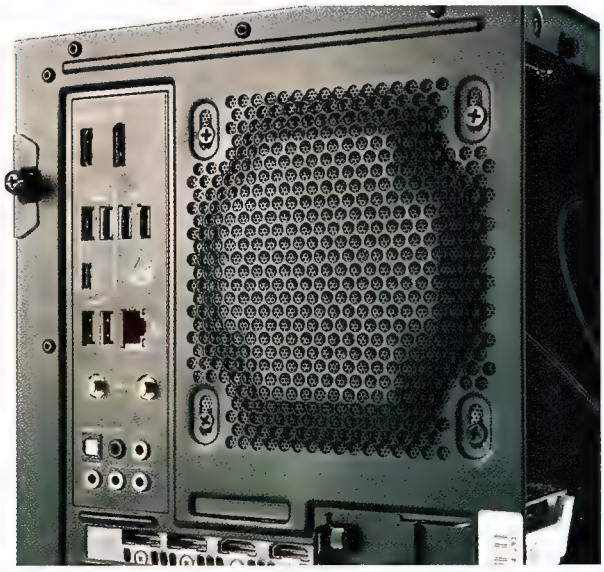
PART		STREET PRICE
CASE	NZXT H200I	$159
MOTHERBOARD	ASUS ROG STRIX Z390-I GAMING MINI-ITX	$338
CPU	INTEL CORE I7-8700K	$585
CPU COOLER	NZXT KRAKEN X52 240MM AIO	$219
GPU	ASUS GEFORCE GTX 1070 DUAL	$729
MEMORY	32GB (4X 8GB) G.SKILL TRIDENT Z DDR4 @ 3000MHZ	$365
PSU	CORSAIR RM850I 80+ GOLD	$219
STORAGE 1	500GB SAMSUNG 970 EVO M.2 PCIE SSD	$179
STORAGE 2	1TB SAMSUNG 860 EVO 2.5-INCH SSD	$220
OS	WINDOWS 10 HOME 64-BIT	$140
TOTAL		$3,177

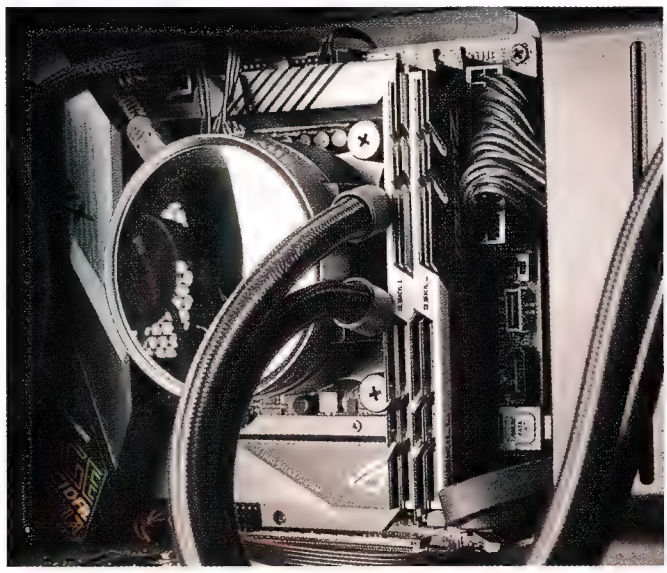
1 H200I SUPERIORITY

As usual, we began the build with a case strip-down. We'll be repeating this until we're blue in the face, but it's so much easier to build a system in a case that has as many of its panels removed as possible. Of course, if you get the opportunity (especially in an ITX build), you should always test your hardware outside of the chassis first, before installing it, because it's easier to return and RMA parts when they've been assembled on top of a motherboard box (all of them are antistatic) than install it all, try to get it to work, then have to pull it all back out, at which point you need to send it back to your eseller of choice. Unlike the H400i variant of NZXT's lineup, the H200i comes with a removable front panel, too, making it easier to install 240mm AIOs in there.

2 USB 2.0 CONUNDRUM

Who'd have thought we'd reach this point? Yes – not enough internal USB 2.0 headers on the motherboard to satisfy our needs. We require two of them, but the Z390-I only supports one. Why two? One for the NZXT H200i's integrated fan and lighting controller, and another to power and control the infinity mirror baked into the NZXT Kraken X52. It's a little frustrating that we can't complete this setup right now, so we've taken the liberty of pre-installing the CPU USB cable, ready for when our additional USB 2.0 internal hub turns up.



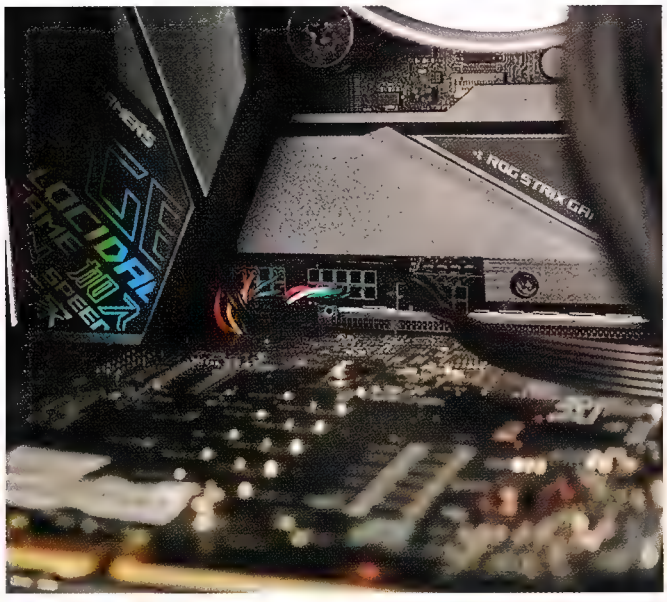


3 REAR I/O PLATE

It might not have enough internal USB 2.0 headers, and that's a bit of a shoddy front panel header (more on that later), but that's not to say the Asus Z390-I ROG Strix Gaming isn't a good motherboard. One thing we're particularly fond of is the inclusion of a pre-mounted rear I/O shield. No more building half your rig, forgetting it's there, sitting at the bottom of the box. We're also in love with the included M.2 heat spreader, which should help dissipate the heat when our friend is hammering in those sequential transfers on his Samsung 970 Evo 500GB.

4 MEMORY MISHAPS

We first specced out this build to use Corsair's Vengeance Pro RGB memory. With white LEDs, these things would have looked baller shining away on the interior of this setup. Alas, the best-laid schemes of mice and men, and all that – we just couldn't get them to fit with the cooler without conflicting with the inlet and outlet ports for the tubing runs to the radiator. There was a solution – rotate the CPU block, so both ports were facing upward – but our OCD was screaming about the misalignment of the NZXT logo (yes, we're that petty). So, we swapped the Vengeance Pros out for a fast G-Skill Trident Z kit instead, which fits just fine here, and doesn't cause any conflict.



5 FRONT HEADER HELL

This is just dumb. What you're looking at in the shot below is the location of the front headers. That's right, sitting directly above the GPU – right in the middle, not at one end or the other – is the front panel header for your on and off switch. Seriously, Asus? This is a premium top-end motherboard, developed for premium-looking systems, and you place the I/O header there? We had little choice but to run the cable along the top of the GPU, and then just hook it out of the way – but, wow, talk about frustrating...

6 SMART FANS?

It's not as smart as we'd like, but the fan controller in the back has been developed to analyse the noise in the chassis and adjust the fan curves for it. Unfortunately, it's a bit sluggish, and takes a ridiculously long time to set up those custom fan curves based on noise. In fact, we recommend you go into the CAM software and set up your own instead. It also supports the integrated LED lighting strip in the top of the chassis, and you can add another (available separately) if you fancy more RGB fun. It supports a bucketload of fans, too, which is nice, as we don't need to plug any into our motherboard. We do recommend plugging your pump into the CPU fan header, though, to stop the Asus motherboard protection causing errors, and preventing you from booting.

1 World of Headercraft is what we should call this build. Seriously, why is this front header here?

2 Cooling is supported by a few Be Quiet! Silent Wing 3s that we had lying around – they're some of our favorite fans.

3 Although not pictured, we have an NZXT internal USB hub on the way to help alleviate our AIO lighting woes.

Work to do?

There you have it: a fairly clean upgraded system. You might be asking what we kept from the old rig, and that would be a fair question. It was the GPU, and only the GPU. As a GTX 1070 Dual is still a fairly recent card (and new Nvidia GPUs are ridiculously expensive), it made sense to hold on to it for now, rather than waste the budget. It's a good card, and as our friend predominantly only plays *WoW* at 1440p, it'll be more than enough to keep him going for at least another 2 years.

That said, ironically, it's probably one of the few things we would change about this system. Getting that out and replacing it with something like an EVGA Black 2080 XC would make the most sense, both aesthetically and for the future life of the system.

All in all, though, we didn't have any major problems when it came to building this system. The only tricky bit was routing those front panel headers on top of the GPU. We also plugged in the HD audio pass-through to the left of it, which means carefully and expertly installing your GPU after you've done that, making sure you don't pinch the cable too badly in-between, but that's an inevitability with a lot of small form factor systems. If this were a build for one of our team, the likelihood is we'd have not installed it at all – after all, pass-throughs are notoriously dirty when it comes to quality audio, and it's not exactly too difficult to install your audio cables to the rear I/O of a machine like this, especially when it'll plop on to most desks with ease.

Performance-wise, the numbers are good, and where we'd expect them to be. Cinebench R15 multicore clocks in at a sweet 1,522, with single-core just nudging the 200 bracket at 197. CrystalDisk read and writes were equally as high, and gaming performance was also fairly well rounded.

What would we change if this were our build? Not a lot. Perhaps different memory. Liquid-cooling this rig, although tempting, isn't particularly viable. The NZXT H200i certainly ain't no Manta, and running a single 240mm rad, regardless of how thick it is, wouldn't be enough to satisfy the cooling of both a GPU and a CPU in a setup like this, especially with a full-length card. It's not impossible, of course, but you have to question whether it would be worth it. The biggest change we could make is to delid that CPU, and drop some liquid metal in it, or at least some better quality thermal paste. A temperature drop here of 10–15°C would make a world of difference, especially in the warmer months. ■

BENCHMARK RESULTS

	APC LABS TEST PC	THIS SYSTEM
CINEBENCH R15 MULTI (INDEX)	1,152	1,456 (26%)
CRYSTALDISK QD32 SEQUENTIAL READ (MB/S)	3,400	3,422 (1%)
CRYSTALDISK QD32 SEQUENTIAL WRITE (MB/S)	1,720	2,324 (35%)
RISE OF THE TOMB RAIDER (FPS)	37	55 (49%)
TOTAL WAR: WARHAMMER II (FPS)	46	71 (54%)
TOM CLANCY'S GHOST RECON WILDLANDS (FPS)	39	56 (44%)
3DMARK: FIRE STRIKE (INDEX)	11,101	16,012 (44%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our Labs test PC consists of an AMD Ryzen 5 1600, 16GB of Crucial Ballistix Sport LT @ 2,666MHz, an EVGA GeForce GTX 1060 3GB, and a 250GB Samsung 960 Evo M.2 PCIe SSD. All tests were performed at 1080p at the highest graphical profile.

how to

» QUICK TIPS

Experts solve your computing problems

APC and its readers can be one giant helpdesk. If you have a technical problem, chances are one of us can solve it.

WINDOWS

FILE EXPLORER'S GLITCHY BEHAVIOUR

I'm currently having two problems with Windows 10: clicking on the Recycle Bin icon on the desktop opens File Explorer, so I can't empty it, and if I open File Explorer from the Taskbar I'm unable to create a new folder – clicking the button does nothing. Can you help please?
Dave Carlile

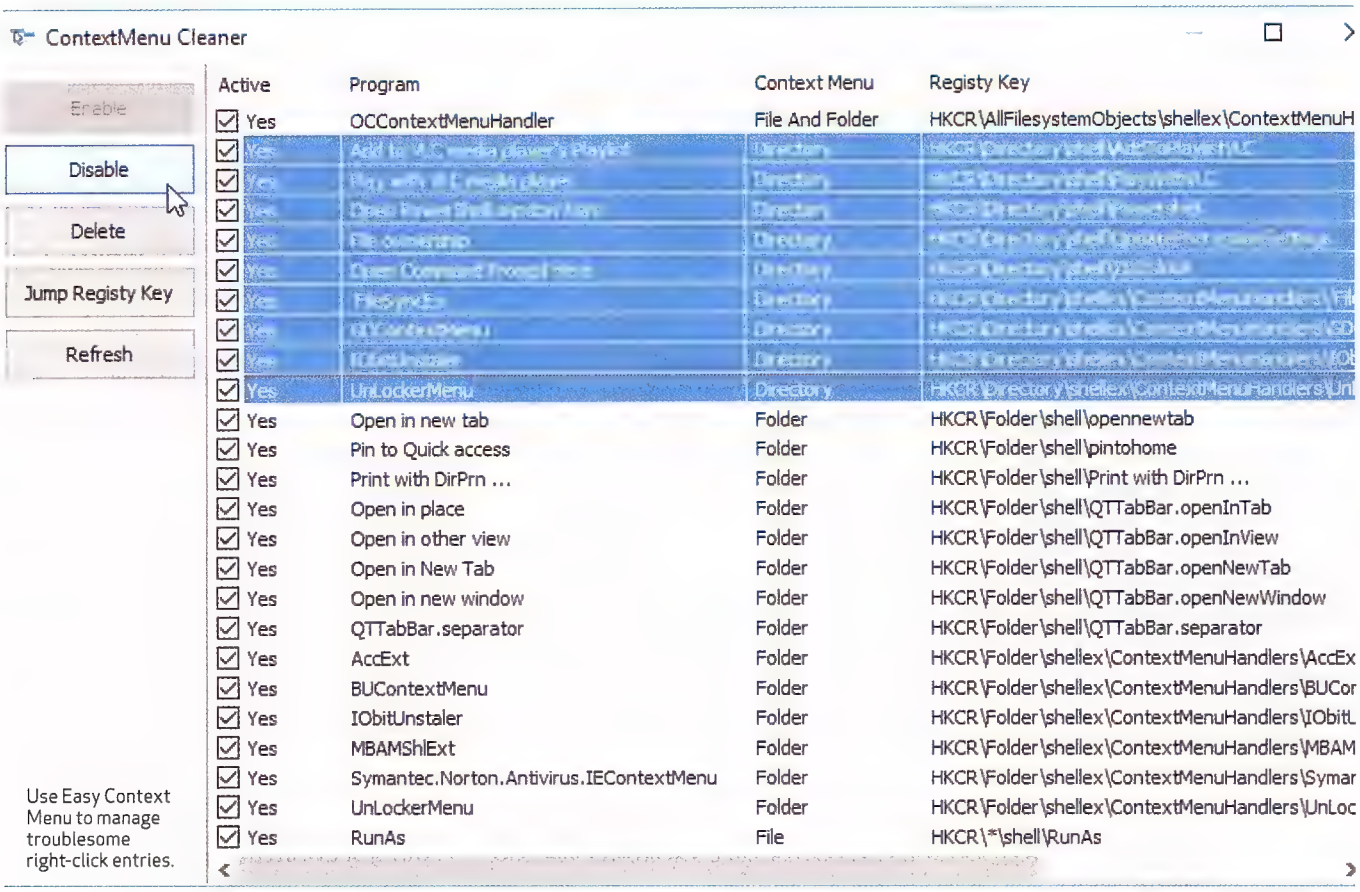
We were able to ascertain that the Recycle Bin was working correctly – clicking it does simply open File Explorer, and Dave confirmed he was able to empty the recycle bin from there or by right-clicking the bin itself). The second problem is almost certainly linked to a third-party program that adds additional commands to File Explorer, typically through the right-click menu. What you need is a program that enables you to see what additional commands have been added, plus allow you to selectively disable them. This is done using a so-called context menu editor. Our current favourite is Easy Context Menu (**www.sordum.org/7615/**), a portable tool that includes a cleaning component. Launch the program and click the icon with the brush. A list of entries will be displayed – click the Context Menu tab, if necessary, to group them by type. Start by pressing Ctrl-A and clicking Disable. All third-party entries should be disabled. If File Explorer now works correctly, you've fixed your problem. You can go further, however, by re-enabling Context Menu entries in groups until the problem resurfaces, and then focus on the last group you added back. Within that group, disable each entry, then re-enable them one at at time and you should be able to track down the exact culprit.
Rob Mead-Green

SECURITY

NORTON DOWNLOADER KEEPS POPPING UP

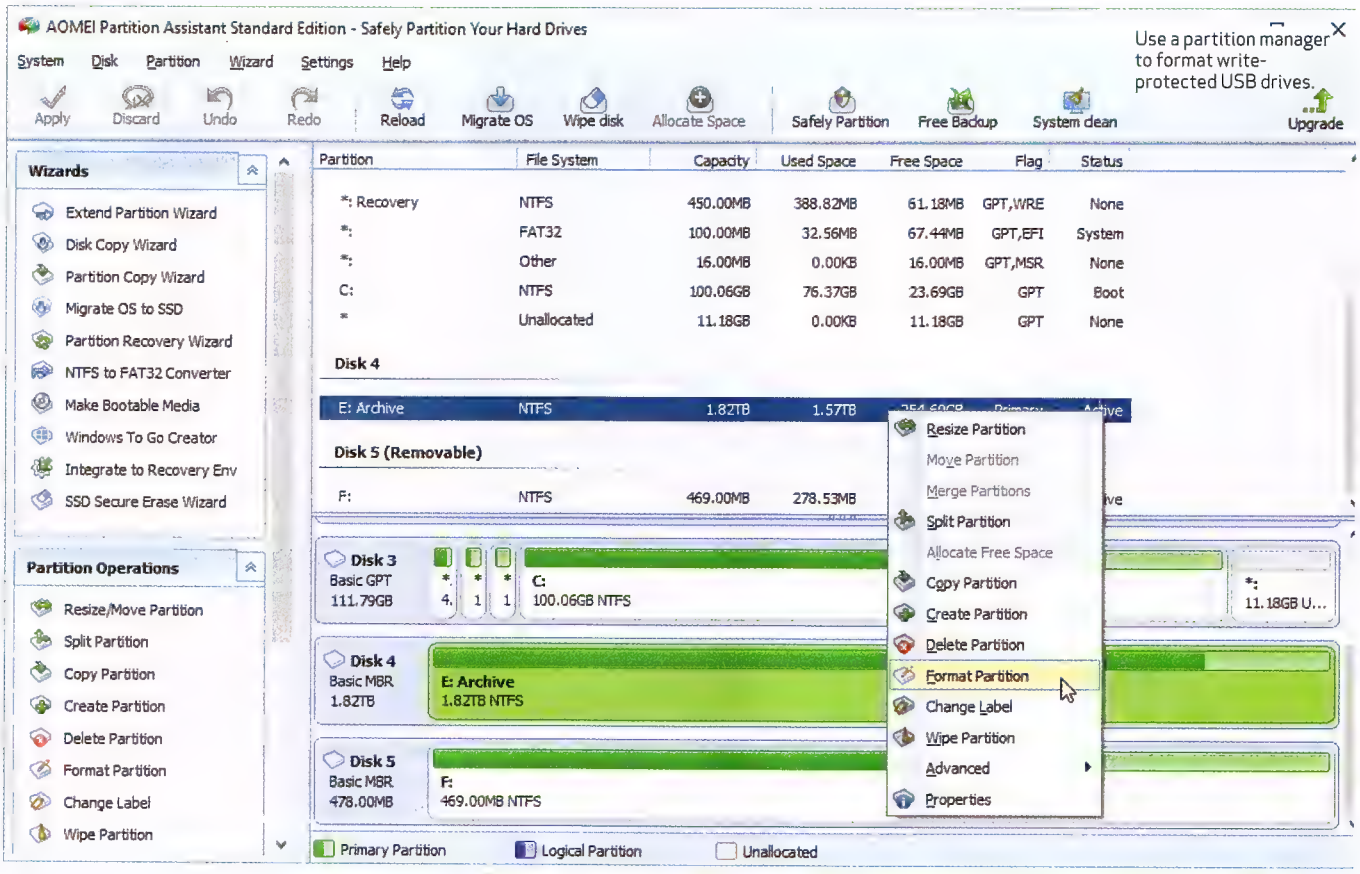
I recently switched to a new security tool, and used the Norton Remove and Reinstall Tool to remove Norton Security. Now Norton Downloader keeps popping up, demanding I download a new copy of the app. It even greys out the 'close window' dialog. How can I get rid of this annoying pop-up?
Frank Wobley

Norton's tool is rather insidious. Start by right-clicking the Taskbar



Active	Program	Context Menu	Registy Key
Yes	OCContextMenuHandler	File And Folder	HKCR\AllFilesystemObjects\shellex\ContextMenuH
Yes	[illegible]	Directory	[illegible]
Yes	[illegible]	Directory	[illegible]
Yes	[illegible]	Directory	[illegible]
Yes	[illegible]	Directory	[illegible]
Yes	[illegible]	Directory	[illegible]
Yes	[illegible]	Directory	[illegible]
Yes	[illegible]	Directory	[illegible]
Yes	[illegible]	Directory	[illegible]
Yes	UnLockerMenu	Directory	HKCR\Directory\shellex\ContextMenuHandlers\Unl
Yes	Open in new tab	Folder	HKCR\Folder\shell\opennewtab
Yes	Pin to Quick access	Folder	HKCR\Folder\shell\pintohome
Yes	Print with DirPrn ...	Folder	HKCR\Folder\shell\Print with DirPrn ...
Yes	Open in place	Folder	HKCR\Folder\shell\QTTabBar.openInTab
Yes	Open in other view	Folder	HKCR\Folder\shell\QTTabBar.openInView
Yes	Open in New Tab	Folder	HKCR\Folder\shell\QTTabBar.openNewTab
Yes	Open in new window	Folder	HKCR\Folder\shell\QTTabBar.openNewWindow
Yes	QTTabBar.separator	Folder	HKCR\Folder\shell\QTTabBar.separator
Yes	AccExt	Folder	HKCR\Folder\shellex\ContextMenuHandlers\AccEx
Yes	BUContextMenu	Folder	HKCR\Folder\shellex\ContextMenuHandlers\BUCor
Yes	IObitUnstaler	Folder	HKCR\Folder\shellex\ContextMenuHandlers\IObitL
Yes	MBAMShlExt	Folder	HKCR\Folder\shellex\ContextMenuHandlers\MBAM
Yes	Symantec.Norton.Antivirus.IEContextMenu	Folder	HKCR\Folder\shellex\ContextMenuHandlers\Symar
Yes	UnLockerMenu	Folder	HKCR\Folder\shellex\ContextMenuHandlers\UnLoc
Yes	RunAs	File	HKCR*\shell\RunAs

Use Easy Context Menu to manage troublesome right-click entries.



and choosing Task Manager, then scrolling through the list of processes to locate Norton Download Manager. Right-click this and choose End Task. Now browse to C:\Users\Public\Downloads\ where you'll see a Norton folder, which you need to delete. Next, visit C:\Program Files\Common Files\AV\ and delete any Norton folder you find inside here. The final step involves removing a Registry entry trying to load the tool on startup – this should be visible using any good startup manager such as Autoruns or – our tool of choice – BootRacer (**www.greatis.com/bootracer/**). Reboot and you should find you're no longer plagued by the pop-up.
Nick Peers

STORAGE
REMOVE WRITE PROTECTION

I have a SanDisk Cruzer Edge 16GB disk, but when I try to format it I receive a message it can't be formatted because the disk is write-protected. I can read the contents fine, but how do I remove the write protection?
Norman

This kind of problem can usually be fixed one of a several ways. Start by opening Registry Editor – press Win-R, type `regedit` and press Enter, then browse to: Computer\HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\StorageDevicePolicies. If the WriteProtect value in the right-hand pane is 1, double-click it and change it to 0. Close Regedit and restart your PC to see if that resolves the problem.

If this fails, any half-decent partitioning tool should be able to bypass the problem – taking AOMEI Partition Assistant Standard (**www.disk-partition.com**) as an example, fire up the program, locate your USB flash drive in the list, then right-click its partition and choose Format Partition; other partitioning tools work in a similar way.

If the problem persists, try deleting all existing partitions on the drive using Partition Assistant, then apply your changes and create a new partition in the empty space – format it as NTFS if possible, or FAT32 if it's smaller than 4GB.
Nick Odantzis

> "Norton Downloader keeps popping up demanding I download a new copy. It even greys out the close window dialog"

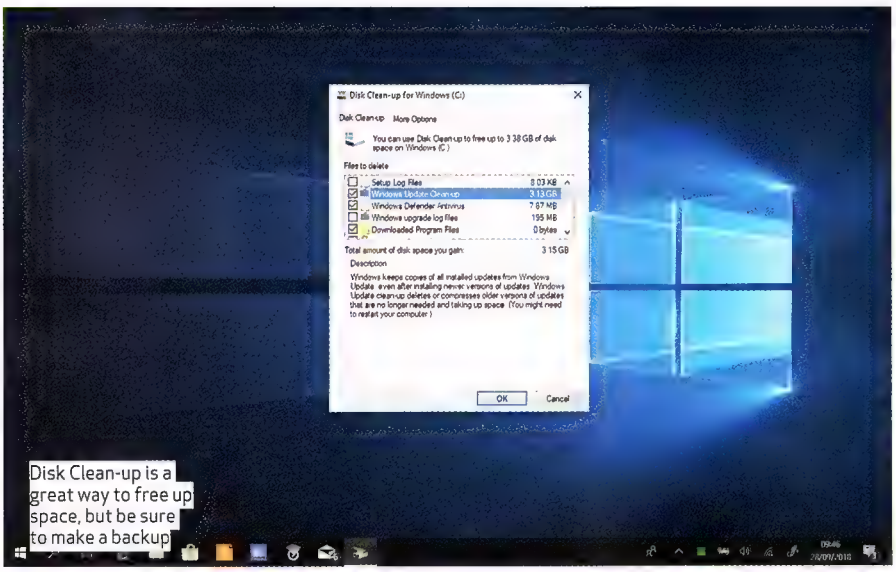
DATABASES
HOW TO SHARE A DATABASE ONLINE

I'm trying to build a relational database for a friend – I used Visual Studio 2017 Community Edition, which worked perfectly until I was asked if I could make it available to a couple more people to access via the internet. Since I'm not a professional developer, is there some way I can do this safely and reliably for free?
Alfonso Papa

Alfonso had already ruled out sharing via a standard cloud storage service – that's because you could cause problems if two users tried to access the file at the same time. Luckily, Microsoft has developed a solution that should suit Alfonso's needs in the form of Visual Studio Live Share (**https://docs.microsoft.com/en-us/visualstudio/liveshare/**), which is available – at the moment – as a free preview.

Failing that, Alfonso might have to consider porting the database to a different platform – Kohezion (**www.kohezion.com**) has a Free Forever account, for example, that supports up to five users, five applications and 15 projects, which should give you some wriggle room with relational databases.

Depending on how your existing database is structured, you may be able to import some or all of it by converting



Disk Clean-up is a great way to free up space, but be sure to make a backup

> "you've been targeted because your email and some old passwords exist on a database containing leaked passwords"

it into a spreadsheet – as it's relational, this may not be practical, but it's worth exploring.
APC Team

STORAGE
FREE UP SPACE ON A SMALL HARD DRIVE

My 2-in-1 PC often fails to download Windows Updates due to a lack of storage space. Can you advise how I can keep things running smoothly?
Joe Bennett

2-in-1 PCs tend to have limited storage space at the best of times, so it pays to try and minimise the wasted space on it. Here are several techniques that can help secure enough space, so Windows Update always operates properly.

Click Start > Settings > System > Storage and flick the 'Storage sense' button on. This enables Windows to automatically clear specific parts of your system, such as temp files and downloads, when you start running out of drive space.

Click 'Change how we free up space' to control how Storage sense works – by default Windows chooses when to run it, but you can force it to run on a schedule. You can also fine-tune when it removes temp files and add downloads, too.

To clean more files from your computer, type `disk cleanup` into the search box to run the Disk Clean-up tool. Click 'Clean up system files' to include additional files – it's possible to free up gigabytes of drive space quite quickly, but as always before this sort of action make sure you have a backup!

If your 2-in-1 device has a microSD card slot, insert a suitable card as extra storage and then move Microsoft Store apps to it via Start > Settings > Apps. Work through the list clicking on apps looking for a Move button to free up extra space.
Nate Drake

SECURITY
HAVE I BEEN COMPROMISED?

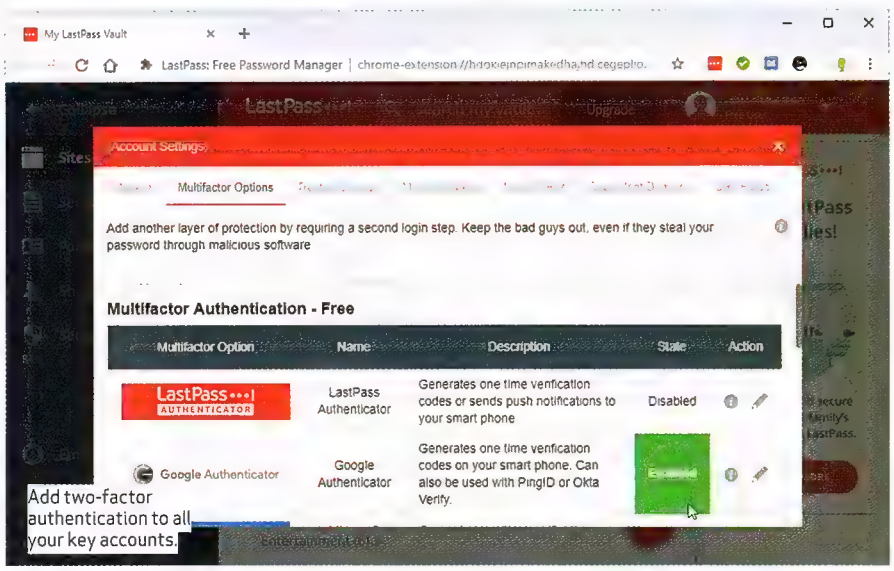
I received an email that concerns me. The subject line appears to list a password that contains some of the characters in the correct order that I've used, and then the email body is basically trying to extort money from me, claiming that I've visited an adult website and that my webcam recorded me 'having fun'. I'm being asked to pay $2,000 to avoid embarrassment. Given I've never visited this (or any adult site), I'm pretty sure it's a scam, but those password characters worry me. Should I be concerned?
David Hargreaves

The email is a complete scam, but there's some truth behind it. First, you've been targeted because your email and some old passwords exist on a database containing old leaked passwords and emails. The threat itself is empty, but it's a timely reminder to make sure you regularly update your passwords and avoid reusing the same ones. Use a free tool like LastPass (**www.lastpass.com**) to generate strong, random and unique passwords for your online accounts, and make the effort to update them every six months or so. Also consider employing two-factor authentication (2FA) for particularly sensitive accounts – use Authy (**www.authy.com**) to enable you to supply 2FA codes from more than one device.
Mayank Sharma

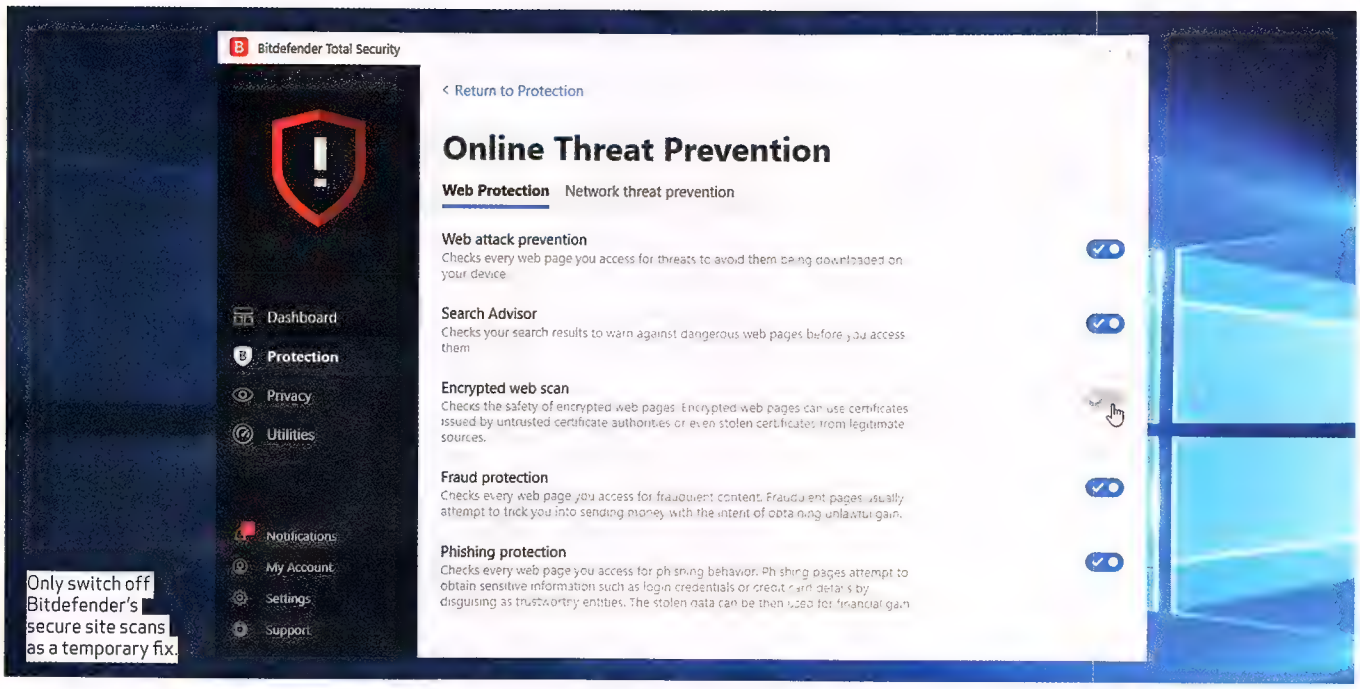
BROWSER
CONNECTION IS UNTRUSTED IN FIREFOX

I've recently updated to the latest version of Firefox, but now several websites – including the likes of google.com – are throwing up a 'this connection is untrusted' message, making it impossible for me to connect. Is this a bug in Firefox?
Leslie Harris

No, it's usually associated with a third-party security program – in Leslie's case this was Bitdefender, which she'd recently installed on her PC. Some security suites intercept secure web connections – to verify they're safe – and then substitute their



Add two-factor authentication to all your key accounts.



Only switch off Bitdefender's secure site scans as a temporary fix.

own security certificate in its place when the site has been verified. The irony is that this can sometimes confuse the web browser when one certificate it's trusted is suddenly replaced by another.

You can temporarily resolve the problem by disabling Bitdefender's encrypted web scan. In the latest version, open the dashboard, select Protection and click Settings under Online Threat Protection. Toggle the 'Encrypted web scan' switch to Off and Firefox should work correctly again. You will, however, see a prompt urging you to switch the feature back on.

If you want a more permanent solution, open the menu and choose Help > Troubleshooting Information. The simplest solution is to click 'Refresh Firefox...', but if you have any plug-ins installed, you'll need to manually restore these unless you've backed them up via a Firefox Sync account. Once Firefox is up and running again, open the menu and click the sync button next to your profile name to restore them.

Ian Sleightholm

WINDOWS

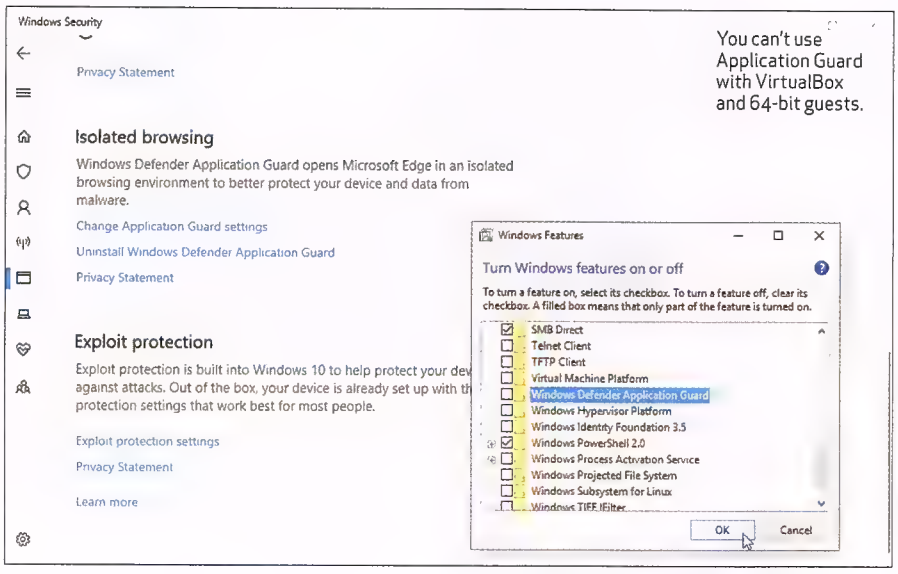
NO 64-BIT OPTION IN VIRTUALBOX

I'm running the 64-bit version of Windows 10 and until recently could create virtual machines on it that were also 64-bit, and so take full advantage of my computer's 16GB of RAM. Now, however, when I come to create a virtual machine only the 32-bit option is available. Can you help?

Josh Ashford

Josh had followed the checks at **https://forums.virtualbox.org/viewtopic.php?f=1&t=62339** and everything appeared to work correctly. He then remembered having followed the guide to enabling Application Guard for Edge, a new feature introduced in the October 2018 Update. Switching this off via Windows Security > 'App & browser control' restored VirtualBox's support for 64-bit guests.

APC Team



You can't use Application Guard with VirtualBox and 64-bit guests.

CLOUD

SEAGATE GOFLEX CONNECTION PROBLEM

I bought a Seagate GoFlex external hard drive around five years ago and have never had any success being able to see it from my phone. I'm trying to create my own personal cloud – I also recently bought a Pogoplug device on eBay, but no luck there either.

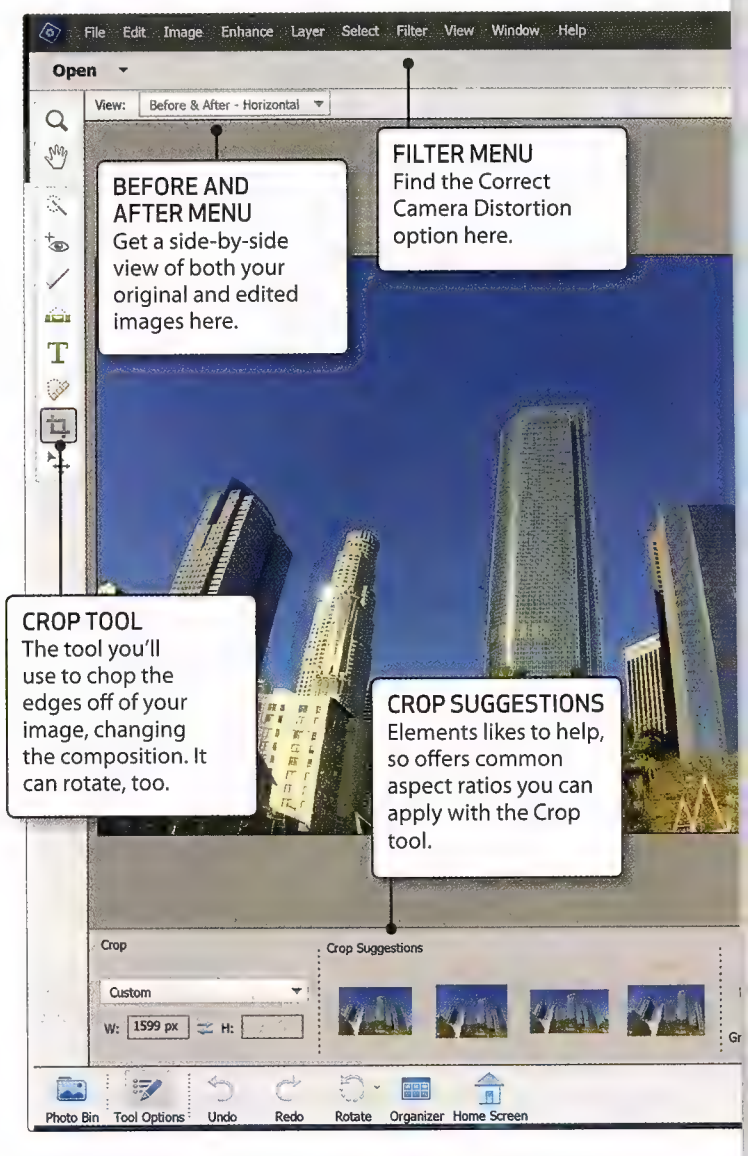
Harry Oakes

Seagate has announced it has dropped support for the GoFlex Home service as of February, and as the iOS app hasn't been updated since 2012 it's time to look elsewhere for a personal cloud solution. Sadly, Pogoplug hasn't been supported since 2016. You could purchase a NAS from Synology or QNAP with built-in app support for open-source solutions such as OwnCloud or NextCloud but, unfortunately, these don't come cheap. If your Seagate is functioning OK, we'd suggest using it as 'dumb' storage in conjunction with a Raspberry Pi following the instructions at **https://tinyurl.com/apc466-picloud** – the end result will be a personal cloud accessible from all of your mobile devices as well as from your desktop PC and laptops.

Mayank Sharma

Fix distortion in your photos

Ian Evenden explains how to repair wonky, bendy or otherwise distored photos in Windows 10.

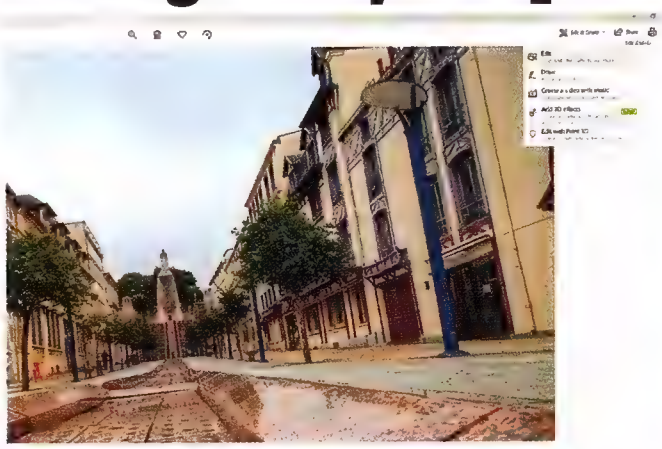


One of the simplest and most effective edits you can make to a photo is to straighten it. We humans rarely have built-in level indicators, and it's easy to end up taking a photo that's wonky. Even with in-camera levels, which project information into the viewfinder, your images can still come out with a lean.

Even worse is the effect that lens distortion can have on tall buildings. As you lean back to fit a skyscraper into the frame, the bottom of the tower block can bulge out, while the top shrinks rapidly, becoming narrower as it moves away. That's if it's in the centre of the frame – put a tall building at the edge of a photo taken with a wide-angle lens and it can appear to lean over, Pisa-style.

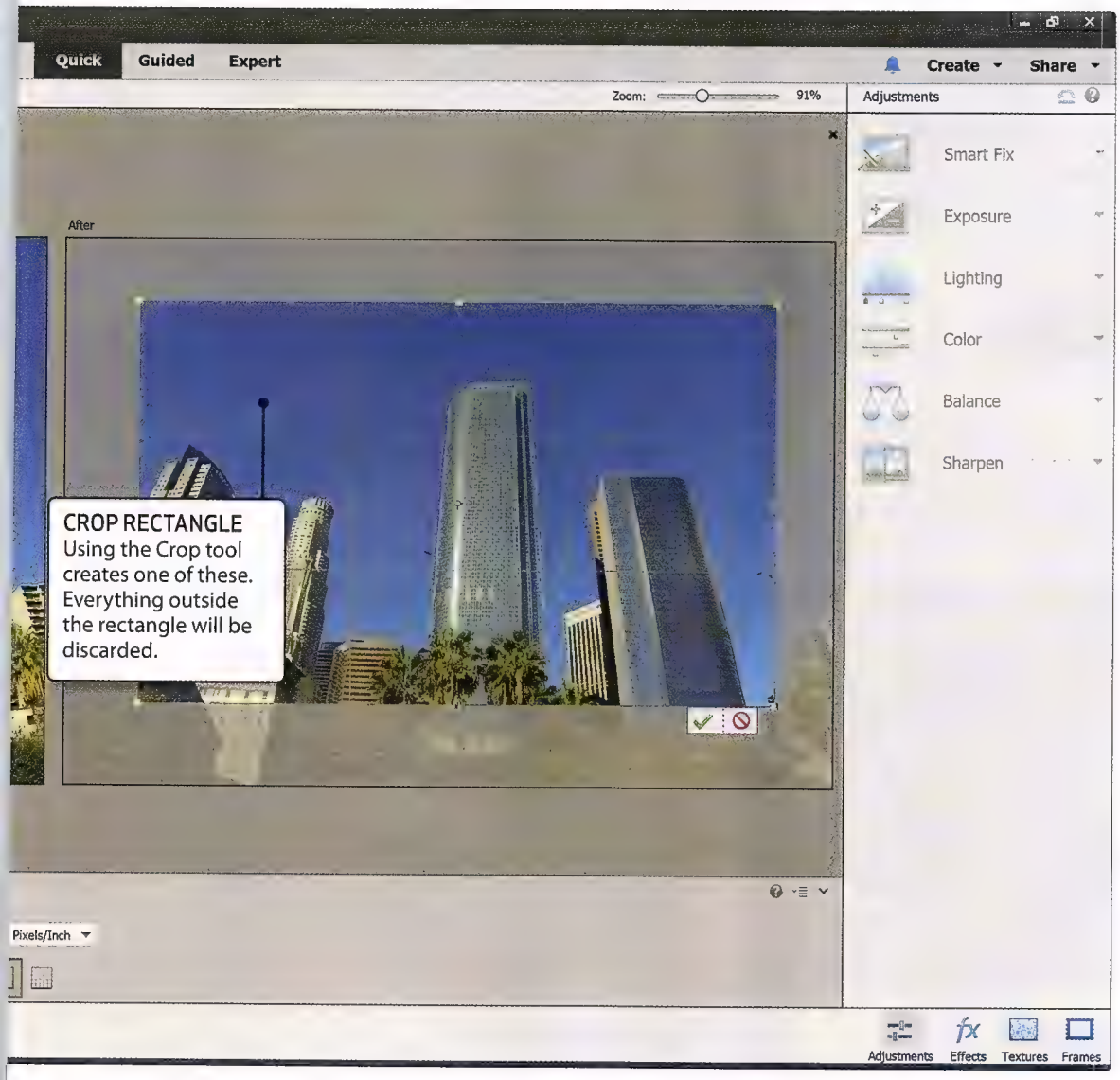
Follow the steps below to find out how to fix this in Windows 10's Photos app or Photoshop Elements 2019 (download the free trial from **http://bit.ly/PSE19trial**).

Straighten your photos



1 STRAIGHTEN IN PHOTOS
If you have an image with a horizon that's non-horizontal, it can be sorted out in a couple of seconds using the cropping and rotation tool in Windows 10's Photos app. Open your image in Photos, and launch the Crop tool by dropping down the 'Edit & Create' menu. Choose the top option – Edit. If the menus aren't visible, click once anywhere on the image and they should fade in.

2 PHOTOS' CROP TOOL
Using the Crop tool to straighten a photo is effective, but often means you lose some of your image. Click 'Crop and Rotate' (top right), and you'll get a white rectangle around your image. You can pull its corners in to crop, but to straighten use the Rotate tool at the right. Drag the white ball up or down – a grid will appear, making it easy to see when something's straight.



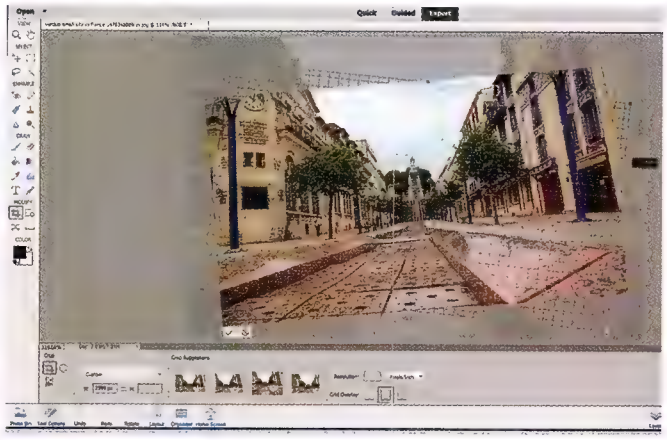
Jargon buster!

ASPECT RATIO
The relationship between the horizontal and the vertical sides of an image, expressed as a ratio – such as 16:9.

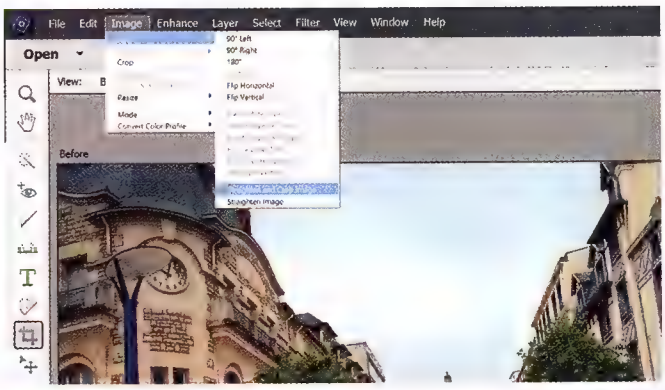
CONVERGING VERTICALS
The way the sides of a tall building appear to no longer be parallel in a photo.

LENS DISTORTION
Bulging out or pinching in of the centre of an image, caused by the properties of the lens that it was captured through.

3 PHOTOSHOP ELEMENTS' CROP TOOL
In Adobe's app, the Crop tool is available in both Quick and Expert modes. Photoshop Elements 2019 will attempt to suggest crops you might like on your image – usually aspect ratios such as 16:9, but we're here to straighten, not to crop. Areas outside the crop area are fogged, so it's always clear what you'll be left with at the end of the cropping or straightening process.

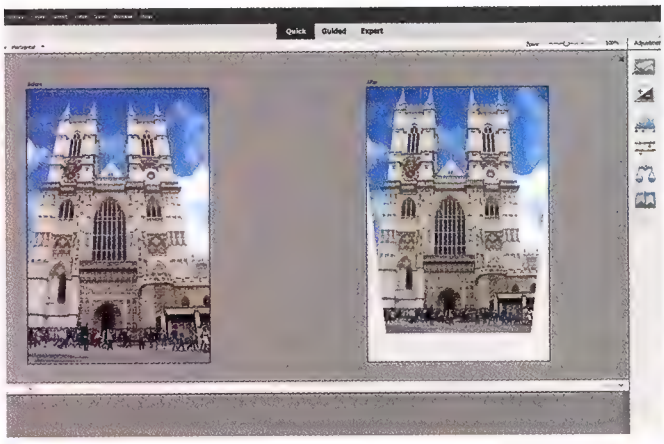


4 CROP TO ROTATE
Drag a crop rectangle across your image, or use one of the presets. Then drag up or down near the edge of the rectangle but outside it – it will fill with a grid and rotate, so you can line up a part of the image you want to be straight. If you drag inside the rectangle to begin with you'll end up moving the crop rectangle around, which is useful but not what we're trying to do here.



5 STRAIGHTEN IMAGE

Drop down the Image menu in Photoshop Elements, select Rotate, and a sub-menu appears with Straighten Image and 'Straighten and Crop' options. These try to straighten your photo automatically, and choosing the second option will crop in so any white edges left by the straightening process are removed. The manual method using the Crop tool is far superior, though.



7 CHANGE YOUR PERSPECTIVE

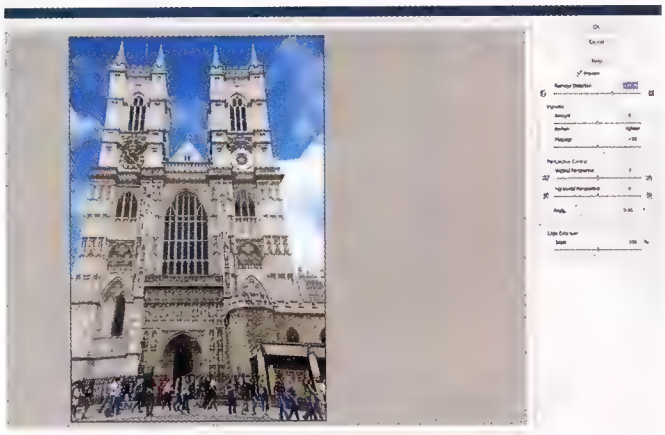
Leaning buildings and converging verticals can be corrected with the Vertical Perspective slider. When you adjust the perspective, the base of the building will get narrower and the top wider – keep moving the slider until it looks natural. As it's adjusted, the image will be cropped in so that any empty pixels around the edges aren't shown.

9 ADUST THE ANGLE

Below the perspective sliders is a circle marked Angle. This rotates your image in the same way the Crop tool can, but you drag your mouse over the circle to perform the rotation. Again, the image will appear to zoom in, as Photoshop Elements crops out any empty areas created at the edges of the image. When you're happy with your rotation, click OK.

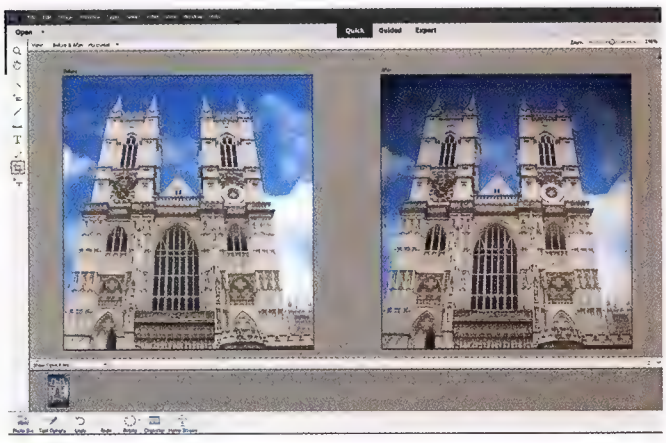
6 CORRECT CAMERA DISTORTION

Found in Elements' Filter menu, Correct Camera Distortion is a way to correct some of the most common lens distortions that lead to bendy buildings or wobbly horizons. There are tools here to correct the perspective and the angle of your photo, and a Show Grid button that superimposes horizonal and vertical lines over your image so you can check for straightness.



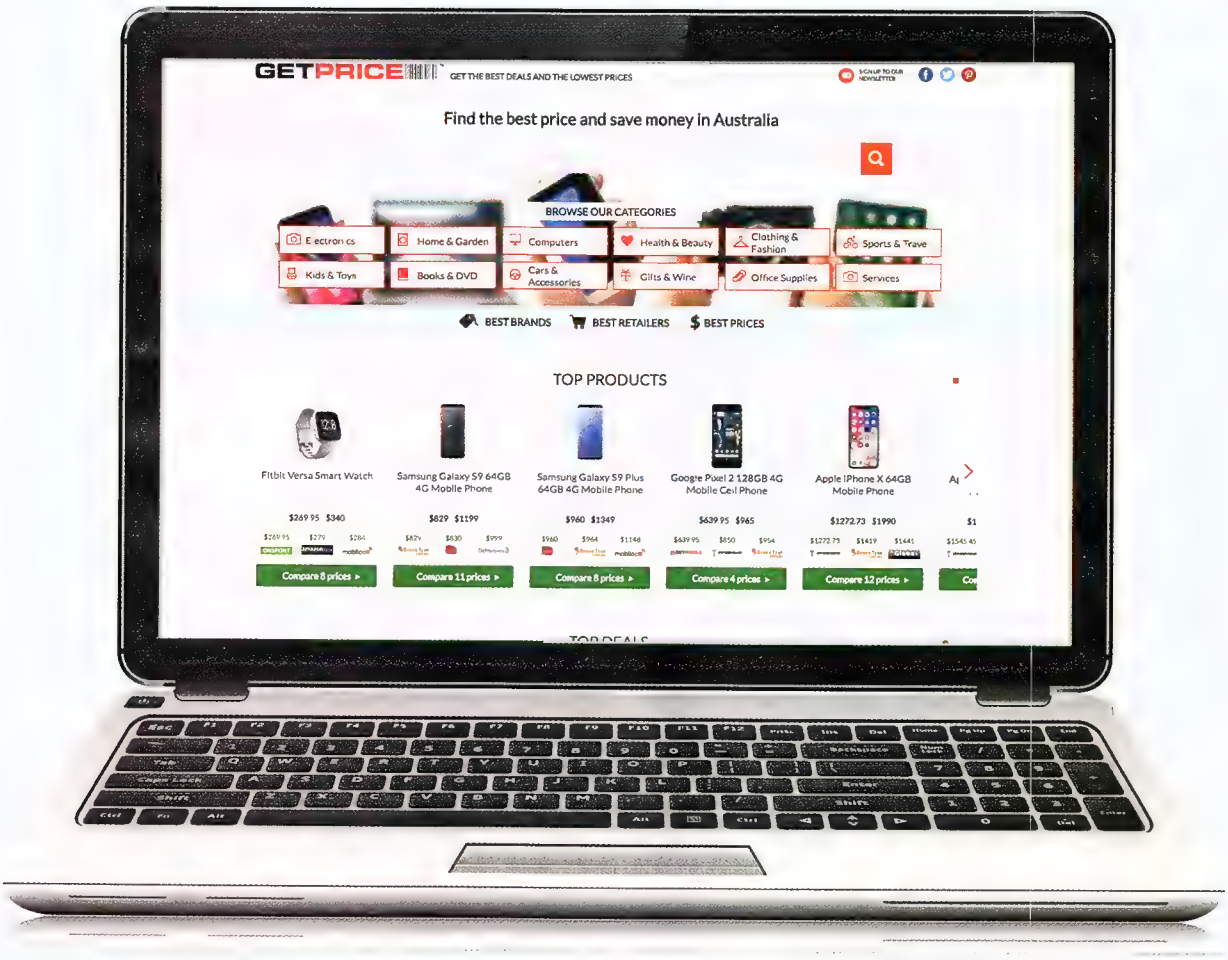
8 LENS DISTORTION

Some lenses can make the centre of the image bulge out (known as barrel distortion) or pinch in (known as pincushion distortion). This can be corrected using Correct Camera Distortion, which features a single slider (top right). Sliding this to the right increases pincushioning, and therefore reduced barrel distortion, while sliding it to the left has the opposite effect.



10 ADD/REMOVE VIGNETTING

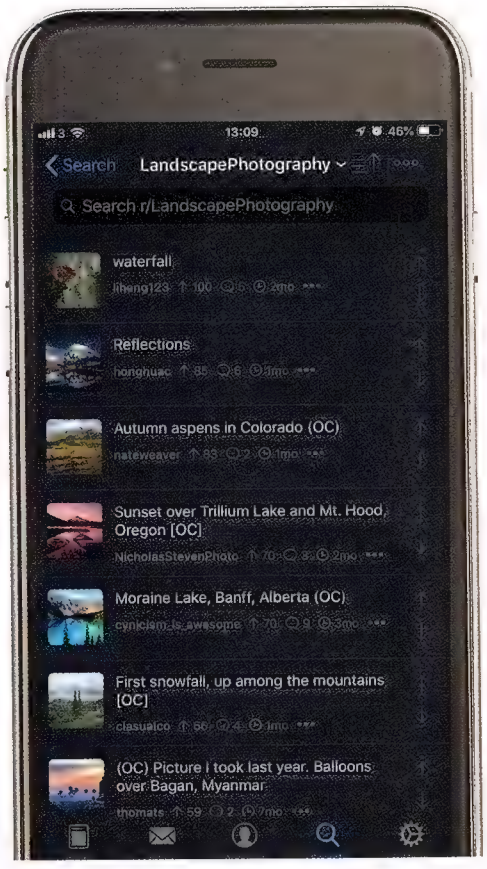
Not really a distortion, but corrected in the Correct Camera Distortion window, vignetting is a darkening of the corners of an image caused by light hitting the lens at a strong angle. The Amount slider to lighten the corners goes both ways, so can be used to create a vignette, too. The Midpoint slider controls how far into the image the darkening creeps.

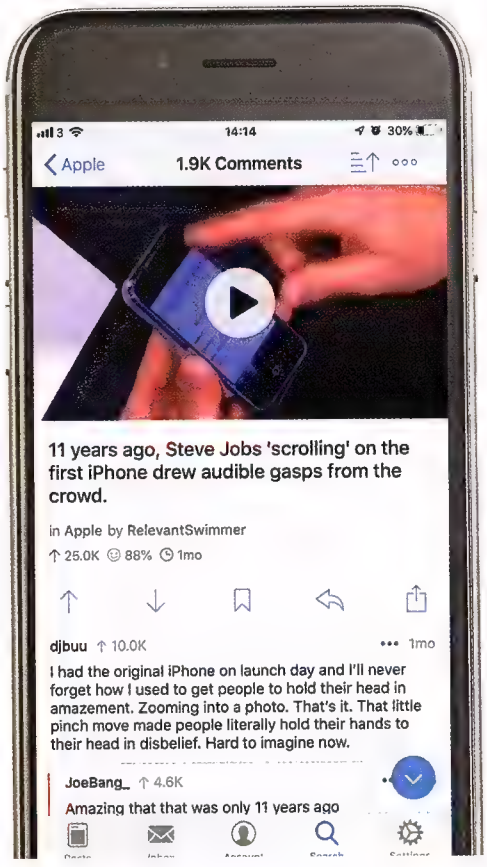


Find the best prices on the latest tech.

www.getprice.com.au

GETPRICE™





Find your favourite topics

Alex Blake explains how to get a better mobile experience from the popular discussion website Reddit..

Reddit calls itself "the front page of the internet", and there's certainly no shortage of stuff to read on the website. The site is divided into sections ('subreddits'), each of which is a forum full of threads and topics. From Apple discussions to adorable dog videos – if you can imagine it, there's probably a subreddit for it.

Despite that, reading Reddit topics in Safari or the Reddit app on your iPhone can be less than satisfactory, and that's where Apollo comes in. Developed by a former Apple engineer, Apollo is a fantastic way to read about subjects you love on your iOS device.

Apollo combines ease of use with lots of excellent features. It's quick and painless to add your favourite subreddits to the app, and Apollo gives you plenty of options to customise its look and feel to your liking, such as how posts are sorted and what apps are used to open links. And, most importantly, reading topics in Apollo is a lot more pleasant, especially compared to Safari.

Customize Gestures

In posts, comments, and more, customize the swipe gestures to whatever actions best fit your browsing habits.

Better Media Data

Improved display and detection of certain kinds of media that require more work to decipher (great for albums). Imgur charges me for access so I had to make this Pro.

Keyword Filters

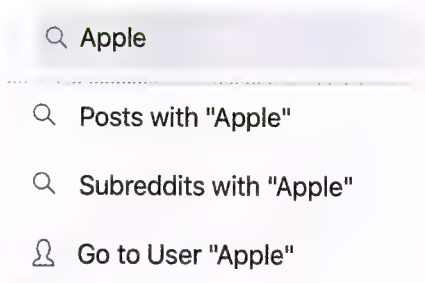
Some content popping up that you're not really interested in? A few keywords and

Apollo Pro

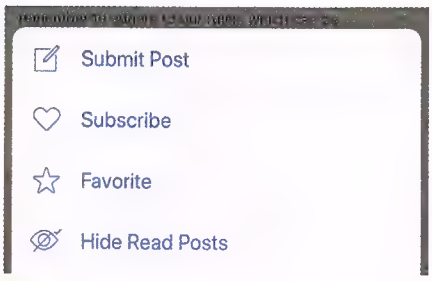
A wealth of bonus features for a price you choose.

We love the free version of Apollo, but its paid-for Pro edition has even more on offer. Some are subtle improvements, such as setting a default subreddit to load or an automatic dark mode that changes based on the time of day. Others give you more power, like the ability to add custom gestures and multiple accounts. Apollo Pro lets you log in with Face ID, Touch ID or a passcode, and it even gives you custom app icons. Unlocking these features and more requires a one-off 'donation' of either US$2.99 or US$4.99 – it's up to you which you pay.

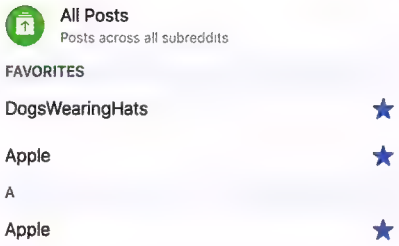
how to
Subscribe to a topic



1 ADD A SUBSCRIPTION
Subscribing to a subreddit means you'll see posts from it when you open Apollo. To find a subreddit you want to subscribe to, tap the Search icon and type a topic. Tap a subreddit, then tap the ellipsis (top right), then Subscribe.

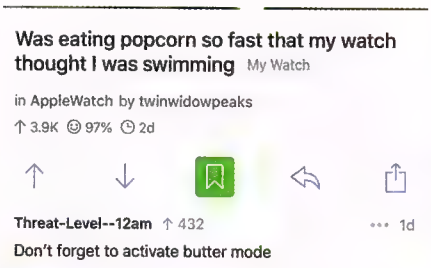


2 ADD IT TO FAVOURITES
Apollo enables you to add your chosen subreddit to your favourites, which can be handy if you've subscribed to a lot of them. On the subreddit's page, tap the ellipsis again, then tap Favourite to add it to your favourites list.



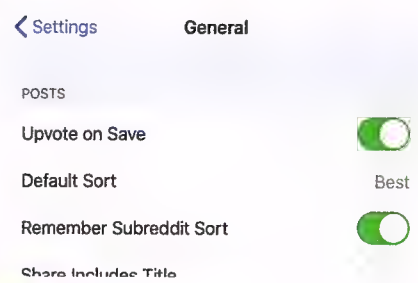
3 ACCESS YOUR FAVOURITES
For easy access, your favourites appear at the top of your subscribed subreddits list in the Posts tab. You can also tap on the name of the subreddit you're browsing, at the top of the screen, to see a list of your favourites.

how to
Save a post for later



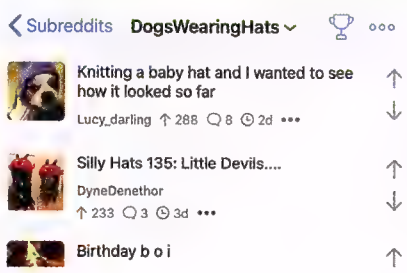
1 ADD TO YOUR SAVED LIST
If you see a post you want to read later, add it to your Saved list. When browsing posts in a subreddit, tap the ellipsis under one, then Save. Or, if you've tapped into a thread, tap the bookmark icon next to Reply under the initial post.

2 VIEW SAVED POSTS
To see all of your saved posts, tap the account icon in the bottom bar, then tap Saved. This list is helpful if you don't have time to read a post when you first see it, or feel it may be useful later but might be hard to find again.

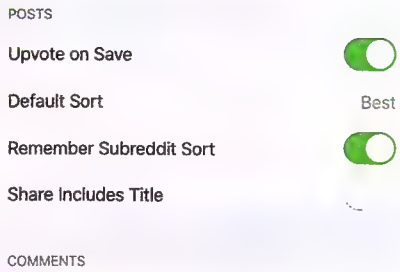


3 UPVOTE ON SAVING
You can 'upvote' posts if you like them in order to show your appreciation. If you find yourself frequently saving posts but forgetting to upvote, go to Settings > General and turn on Upvote on Save to have Apollo do it automatically.

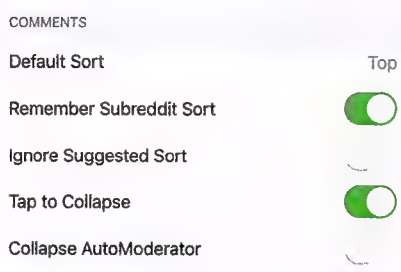
how to
Change the viewing mode



1 COMPACT MODE
By default, Apollo shows Reddit posts with large image thumbnails. You can change that to a more compact mode so you can see more posts without scrolling. Go to Settings > Appearance > Post Size and choose Compact.



2 SORT IT OUT
Reddit has several ways of displaying both posts and comments. For example, you can have the most popular posts at the top, or the most recent comments. In Settings > General, set the Default Sort item under Posts and under Comments.



3 TAP TO COLLAPSE
A comment (and any replies to it) is reduced into a single row when you tap it. This can help you navigate busy threads, but you may find yourself doing it accidentally. To turn it off, go to Settings > General and turn off 'Tap to Collapse'.

Declutter your Mac's menu bar with Bartender

Daryl Baxter explains how to arrange icons to make things manageable.

Regardless of which Mac you have, you always want to make sure that three areas are given your personal touch; the Dock, the desktop and the menu bar.

While the first two are relatively easy to organise, it's a slightly more complicated affair to keep the icons at the right end of the menu bar under control. That area can get crowded, making things hard to find or notice.

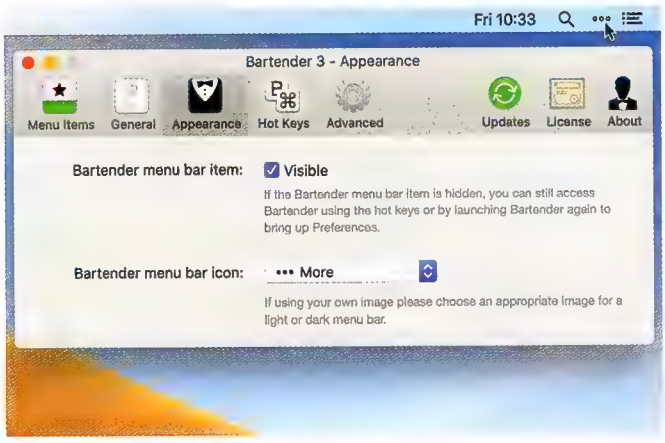
This is where Bartender 3 (**$21.93 macbartender.com**) is useful. Its purpose is to declutter and rearrange the menu bar icons to your needs, providing you with the option to hide and reveal icons as and when you want.

Let's get down to giving your menu bar an unseasonally early spring clean! After you install the app, you'll eventually close its preferences window. To get back to it, Option-click the app's menu bar icon or, if you hide that, open Bartender from Finder.

1 TAILOR EACH ICON
Set visibility and searchable names for menu bar icons here. (So, you may want to type 'wi-fi', not 'AirPort', to reveal that icon.)

2 KEEP IT AROUND
Bartender doesn't open at login by default. It's wise to alter that, so your icon arrangement kicks in whenever you use your Mac.

Customise the menu bar



1 ONE MORE ICON BETWEEN FRIENDS
Bartender adds its own icon to the menu bar. Click it and the app will toggle the menu bar icons between two states: those whose visibility is set to Show and those set to Hide. Icons you need only occasionally are good choices for the latter category.

2 ALWAYS SHOW AN ICON
There are some exceptions. Set an icon to Always Show and it'll be visible regardless of Bartender's state. Pick Always Hide and it'll appear only if you: press the Search hot key and type its name; press the Show All Items hot key; or follow our third step.

Bartender 3 - Menu Items

Advanced | Updates | License | About

AirPort - Wi-Fi

Menu bar item should: Show

Sets what Bartender should do with the apps menu bar items.

When item updates: Show for updates

for: 15 Seconds

If the item is hidden and Bartender detects a change in the menu bar item it will display it in the menu bar for the selected time.

Text search name: AirPort - Wi-Fi

When searching for menu items you can choose a custom search name to use.

Fri 11:11

3 BARTENDER'S ICON
You can pick from premade designs or your own, or wholly hide it; hot keys will still work, and you can open the app's prefs from Finder.

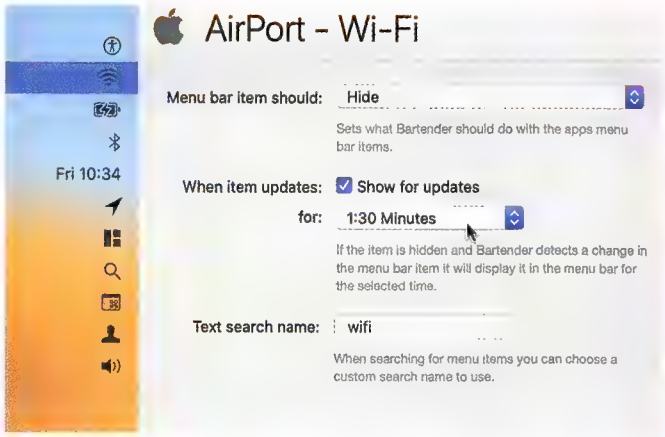
4 REFRESH RATE
To save battery power, reduce the frequency at which the tool checks for status updates that change the visibility of icons.

Jargon buster!

HOT KEYS
are keyboard shortcuts used to invoke the app's key features from anywhere on your Mac. Make sure you set key combos that don't conflict with other apps.

Genius tip!

If icons that are set to Hidden are currently shown, they hide again when you switch app. You might turn that off (in General prefs) to co-opt the two visibility states so each contains icons that are related to different tasks.



3 REVEAL ON STATUS UPDATE
No matter which visibility setting you pick, ticking 'Show for updates' will cause the icon to reappear for a limited time if a change in its status is detected. Tools that sync to cloud storage are a good choice for this, to alert you if their connection drops.

4 REARRANGE THE ICONS
Hold Option, then drag icons left or right. Note that even those set to Always Hide will appear if you press the Show All Items hot key. To reset an icon to default settings, select it in the General tab and click the (unintuitive) minus icon below the list. ■

How to track your personal finances

Nick Peers reveals how to claw back control of your spending with the help of this powerful open-source tool.

Do you struggle to stay on top of your finances? Can't ever seem to work out exactly where your money goes or how much is in your bank accounts? What you need is HomeBank, a free tool that enables you to record, track and analyse your financial ins and outs, giving you everything you need to get on top of your money and stay in control of it.

Although HomeBank can be installed direct from the Ubuntu Software Centre, you won't find the latest version there. To ensure you're running the latest build, open a Terminal window (press Ctrl-Alt-T) and then type the following commands:

```
$ sudo add-apt-repository ppa:mdoyen/homebank
$ sudo apt-get update
$ sudo apt-get install homebank
```

Once installed, HomeBank will appear in the Show Applications list. Click to launch it. A welcome dialog will appear, providing a convenient link to the manual (also accessible online at **http://homebank.free.fr/help/index.html**).

Start by creating a new file. You'll run through a quick-fire wizard – step one is to verify the file owner (your username by default, but it can be anything you like) and currency, which should be your native one. Click Change to switch if necessary. Click Next. Verify the correct language and preset file ('en' for English) are selected – these are the categories you'll assign transactions to, and can be edited later. Click Next again.

The third step asks you to create an account. Each HomeBank file – or wallet – can store multiple accounts, so start with your first account. Give it a suitable name – say your bank – and assign it a specific type: bank – think current account, cash, asset such as

Explore HomeBank's main window

1 QUICK ACTION BUTTONS
The toolbar offers a quick and easy way to access HomeBank's most popular functions.

2 ACCOUNTS LIST
All your accounts are listed here, grouped by category. Double-click one to open its own account window.

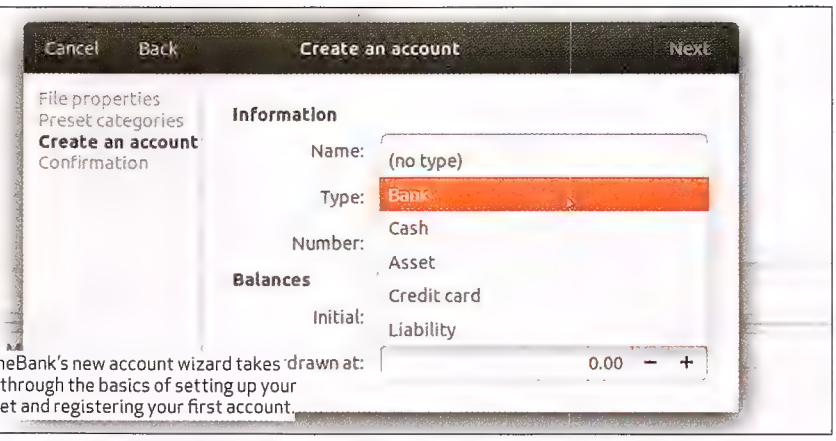
3 REPORTS
HomeBank provides several reporting tools that give you visual insights into how your finances are performing.

4 TRACK SPENDING
The pie chart shown on HomeBank's main screen gives you a convenient look at how your money is being spent.

5 SCHEDULED PAYMENTS
See which recurring transactions – incomings and outgoings – are due in the next few days.

6 ACCOUNT WINDOW
Manage each account in its own separate window. Here, you can add new transactions as well as view existing ones.

"You're now armed with the basics of what you need to take control of your spending."



HomeBank's new account wizard takes you through the basics of setting up your wallet and registering your first account.

savings or pension, credit card and liability – for example, mortgage or personal loan.

If you wish, enter your account number in the Number field. You'll now be prompted to set the initial balance. This is effectively the point you're going to start monitoring the account. You could start with the closing balance of your last statement, but we suggest choosing an arbitrary date up to three months ago and start from there. Diligently entering transactions from your statements will help you get familiar with HomeBank's interface.

The final figure – Overdrawn at – should be left zero unless you have an interest-free overdraft facility, in which case enter that. Click Next > Apply. Note, you can change this information at any time via the Manage > Accounts menu where you'll also find space for additional information like the chequebook number to start counting forward from. This is also where you go to create all the other accounts you wish to track.

IT'S A TRANSACTION!

HomeBank will now take you to its main screen, split into three panes. More on this later – for now, choose File > Save to save your file for the first time. Once done, double-click your account in the main window and you'll see a new account window pop up, which is where that account's transactions will be displayed.

To enter your first transaction, click the Add button in the bottom-left corner. A pop-up dialog reveals what you can record about the transaction: today's date is selected by default, but you can choose a different one. The amount field is critical – you need to make sure you enter a negative figure (such as -5.00) for a payment, so click the +/- button to change it to a negative if necessary.

The box on 'How data is broken down' (*right*) explains how some of the other fields here work: payment is the type of payment, deposit or transfer between accounts you're making, while the Info field is usually used to record a cheque number or other related numbers. The payee field refers to the business or person you're paying – as you enter these, HomeBank will automatically store the names, making repeat payments simpler and more consistent in future.

The Category field is essential for tracking your spending in more detail – many pre-filled categories are supplied, some rather quaint (Tapes and CDs?), but you can edit these via the Manage > Categories option on the main window. Categories are either expenses or income (they can't be both), so if you enter the wrong figure, say a positive number in an expense category, you'll see an amber alert.

Selecting categories from the drop-down menu is incredibly time-consuming. Instead, start typing the category or subcategory you wish to use. HomeBank will display a list of matching categories enabling you to quickly click the one you wish to use. The format is category:subcategory and the quickest way to create your own is to simply type it here – for example, 'Hobbies/Leisure:CDs, DVDs and Blu-rays'. It'll then be added as a subcategory and made available to all other transactions.

You'll notice four Status buttons appear: these enables you to verify if a payment has cleared (appears on your account) or reconciled (appears in your statement). The Remind option is for future payments you need to make manually.

The final two fields – Memo and Tags – are optional. Use Memo to record information about the transaction such as its purpose (paying a specific bill? Bought a particular Blu-ray?), while Tags offer another way of tracking spending. Use it to add another extra layer of detail to your transactions – you could, for example, tag a specific type of spending within a category for future reference.

Once you've input your transaction, click Add to add it, or Add & Keep to add the transaction, but create a new transaction pre-populated with the previous one's contents. You can then move on to the next transaction, and so on and so forth. Click Close when you're done.

How data is broken down

HomeBank records your finances through several layers of data. At the top is your main file, or 'wallet' as HomeBank describes it. Beneath this is the account level, where you can store multiple accounts — current, savings, credit card, and even loans and mortgages. The final, bottom layer is transactions, which are attached to specific accounts.

Each transaction is assigned a specific type of payment, from credit or debit card, electronic payment and direct debit or standing order to deposit, cash, financial fee (for example, a non-sterling payment charge when paying for goods in a foreign currency) and transfer between accounts. Choose Internal Transfer if you wish to transfer money from one account in HomeBank (say savings) to another (your current account, or perhaps your credit card when paying the bill).

Transactions are also assigned to categories, which help you track specific spending. These are user-definable, and you can split a single payment or deposit between multiple categories. You can also manage transactions using keyword tags and the memo, which enables you to record a description. You'll also record the 'payee', the person or institution you're paying (or receiving money from). All these fields can also be used to track certain types of spending later.

Entering every transaction is time-consuming, even allowing for *HomeBank's* built-in auto-fill shortcuts for payees and categories. Thankfully, there are four ways to speed this up. First, duplicate an existing transaction – select the one you want to use as a basis for your new transaction, then choose Transaction > Inherit. Make any changes – such as the date and amount – before clicking Add.

The second method involves scheduled transactions – recurring income and expenditure that occurs on a regular basis, from your monthly mortgage payments to quarterly direct debits. The third option is to set up transaction templates, which pre-fill as little or as much of a transaction as you wish. This is perfect for irregularly recurring one-off transactions, like feeding your second-hand DVD habit.

Set up both from the Manage > Scheduled/Template menu from the main HomeBank window. Choose the type of transaction – scheduled or template – at the top, then click Add to create your first transaction of this type. The name of the template – (template 1) by default – is set in the Memo field, while the rest of the form is identical to a regular transaction. If you choose Scheduled over Template, you'll also gain access to a Scheduled insertion section where you can choose the next payment date, and set future automatic payments and even adjust for weekends. Tick Activate to make the schedule active, and make use of the Stop after section if you're setting up a finite number of payments (for example, for a six-month loan).

From here scheduled transactions will be entered automatically when their due date falls. You can see a list of upcoming scheduled transactions in the main window, enabling you to anticipate their arrival. Select a transaction and click Post to enter it, or Post & Edit if you wish to change details just for the next payment only (double-click the scheduled entry to make permanent changes via the Manage > Scheduled/Template menu). Finally, click Skip to ignore the next payment.

Once created, templates can be added when you come to add a new transaction – simply click the 'Use a template' drop-down to select them from a list, make any required adjustments and then save as normal.

AUTOMATIC ASSIGNMENTS

The fourth and final option is the Automatic assignment feature, which enables you to set the payee and/or category fields automatically based on a text string found in the payee or memo fields. For example, if you were to enter 'music DVD' in your memo field it could be used to assign the appropriate subcategory automatically.

It's primarily designed to help correct issues after importing data from another program, but we see two additional uses for it: to tidy up previously entered data; or simply to speed up transactions entries by enabling you to fill in just part of the transaction before running the assignment to automatically fill in the rest.

To set this up, select Manage > Assignments on the main screen and click Add. First select the condition – in other words the rules that determine if the assignment is automatically triggered. Select where to search (memo or payee), enter your text string and then select if you wish to match the case. There's also an option for using regular expressions for those proficient in using regex to produce more complex conditions (visit **https://regexr.com** for a primer on the subject).

Once your condition is set you can then choose what payee, category and/or payment type should be assigned to the transaction when the assignment is run. Disabled is self-explanatory, while Overwrite should be used with care. In most cases, we'd recommend choosing 'If empty', which ensures the field is left alone if you've already set it up.

You can set up as many assignments as you wish, but note that you can't run individual assignments independently of the rest – it's very much an all-or-nothing approach. Once set up, automatic assignments are run on an account-by-account basis. Open the account window and choose Tools > Auto.assignments. You'll be told how many transactions have been updated as a result of your assignments and then it's very much a case of job done.

ANALYSING YOUR SPENDING

The simple act of recording your transactions should help you start to take back control of your spending. Just knowing how much money you have in your account after the next cycle of bills have been paid is a great way to curb spending. But HomeBank enables you to dig deeper. As you start to build up your transactions, you'll get an overview of your so-called 'top spending' using the pie chart on the main screen.

By default, this is set up to display your spending by category over the entire period you've been recording your financial transactions. For a more detailed view of specific subcategories – say the cost of servicing your car – click Subcategory. You can also focus in on specific periods by clicking the Entire range drop-down menu – options include the previous 30, 60, 90 or 365 days, plus this or the previous month, quarter or year.

This is a handy overview, but you can go further. You'll see a series of five icons above this view offering you more ways to analyse your accounts: statistics, trend time (see how your spending is concentrated into specific periods), balance report, budget report

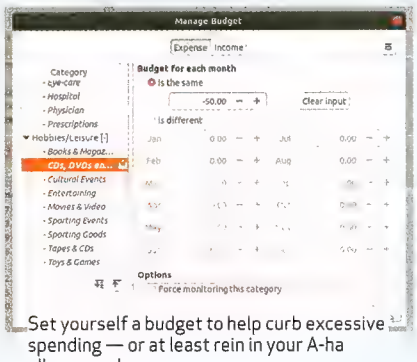
Setting budgets

One way to curb your spending is by setting monthly limits on what you spend on specific categories. By default, all accounts are included in budgets. If you want to exclude individual accounts for any reason, open Manage > Accounts from the main screen, select your account and tick 'Exclude from the budget' on the Options tab.

Next, set your budget or budgets via Manage > Budget. Verify that Expense is selected, so only expense-related categories and subcategories are visible. Select the one you want to track. From here you can set a monthly budget or set budgets for different months of the year. When entering your budget, remember to add the minus (–) figure before it to indicate an expense, and not income, you're tracking.

At the bottom you'll see a 'Force monitoring this category' box — when a specific budget has no spending against it, it's not displayed in the budget report. If you want it to appear regardless, tick this box. Repeat for any other subcategories, then switch to the Income tab if you want to set yourself saving targets, this time setting positive targets against income-related categories and subcategories. Once done, click Close.

Going forward you can monitor your budgets via the Budget report screen, accessible from the main screen's Reports menu.



Set yourself a budget to help curb excessive spending — or at least rein in your A-ha album purchases.

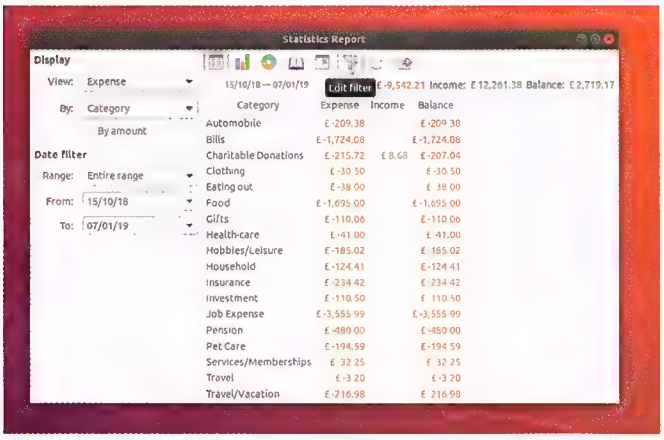
(see the box on budgeting, left) and a special vehicle cost report.

The statistics report is potentially the most useful, and configurable. This opens to show all your expenses divided up into categories, but you can use the drop-downs to track income, expenditure and income, and your account balance, plus filter by subcategory, payee, tag, month or year. Tick 'By amount' to sort the list to show where most of your money is going. There's also a date filter that works in the same way as the main screen, with the added option of specifying an exact date range to track.

Icons across the top of the window enable you to view this information in bar or pie chart form. There are also two additional toggles for displaying additional information: a details pane for displaying all transactions within the selected category or subcategory; and a rate that reveals how the spending breaks down as a percentage. You'll also see a filter button, which enables you to build up a specific view of your spending — the step-by-step guide below reveals how it works. Not only can you display these results on-screen, but there's a button that makes it possible to export the information to the clipboard or a CSV file for accessing in a spreadsheet.

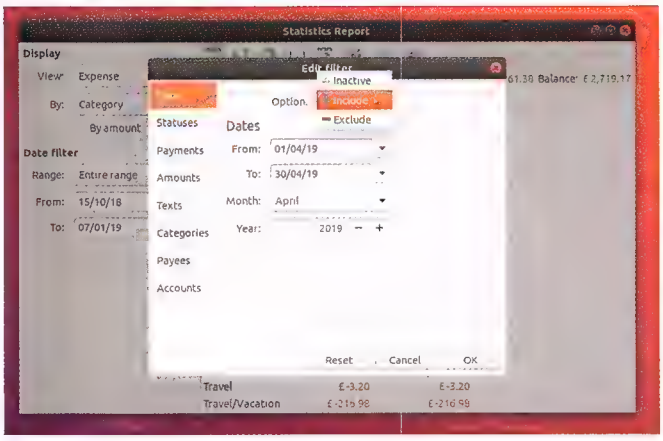
You're now armed with the basics of what you need to take control of your spending. Follow our previous advice to input at least three months' worth of data from your account statements and look to track as many accounts as you can to give you a more accurate picture of your net worth.

Filtering it through HomeBank



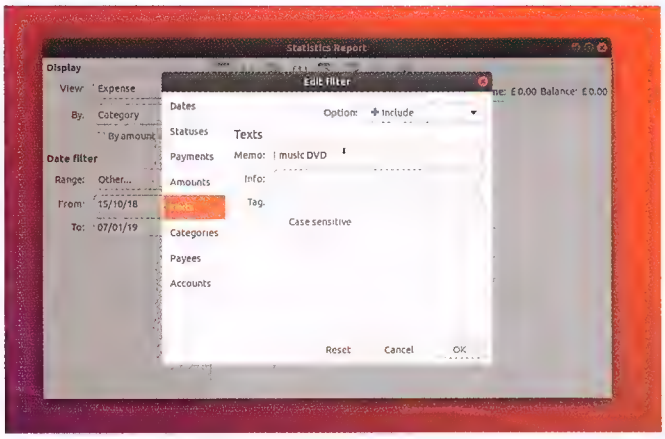
1 CONTROL WHAT YOU SEE

Filters enable you to restrict what HomeBank shows you. They're based on a tightly defined set of criteria, and can be applied both to the Statistics report and any account screen. Set up a filter in a report by clicking the Edit Filter button at the top of the report window. When viewing an account, you'll need to select Tools > Filter.



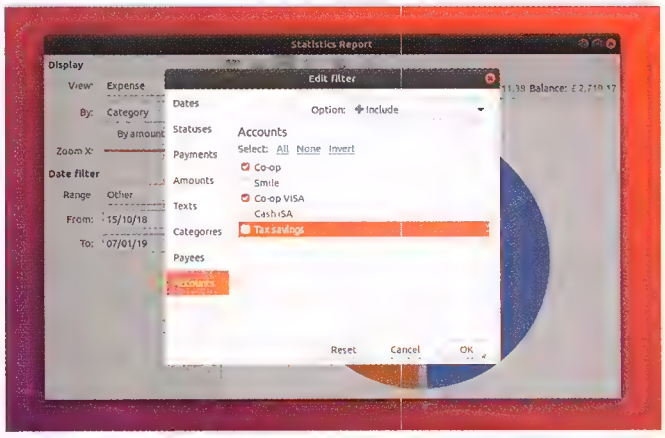
2 SELECT FILTER TYPE AND OPTION

There are eight filter types available, including Dates, Payees and Accounts. You can select one or more types to construct your filter. Start by selecting a filter option: 'include' means only those transactions meeting the criteria (say a date range) are included; 'exclude' means transactions falling outside the criteria are included instead.



3 SET YOUR FILTERS

Each filter has different criteria depending on its type — a range for dates, options for showing reconciled or cleared transactions under Statuses, and so on. Use Amounts to filter payments by their size, while Texts enables you to filter by text string using the Memo, Info and/or Tag fields. Categories, Payees and Accounts filters work by selecting one or more from each.



4 REVIEW AND TWEAK

Once done, click OK to see the effects of your filters. If nothing shows up, reopen the filter dialog and go through your filters again. Be sure to set unwanted filters to Inactive so they don't interfere. Note also that Texts filters work on the entire string — it's not an AND or OR-type filter that's performed. Click Reset to remove all filters if necessary to start again.

Creating a classic system demo

Join the intrepid Les Pounder as he takes you back to the late '80s, when the Amiga 500 reigned supreme and 'demos' were an art form.

For this tutorial we shall take our first steps in creating a video 'demo'. These were popular in the '80s and '90s on the Amiga and Atari computers. They showcased the power of the computer and the prowess of the coder. Typically, these demos (http://ada.untergrund.net) were used by rival "crack teams" who broke copy protection on games. But they grew into an art form that led to many bedroom coders becoming big names in the computing industry. We'll be using Pygame Zero to create our own demo using a little Python code combined with some assets created in image editors and music applications. More on that later.

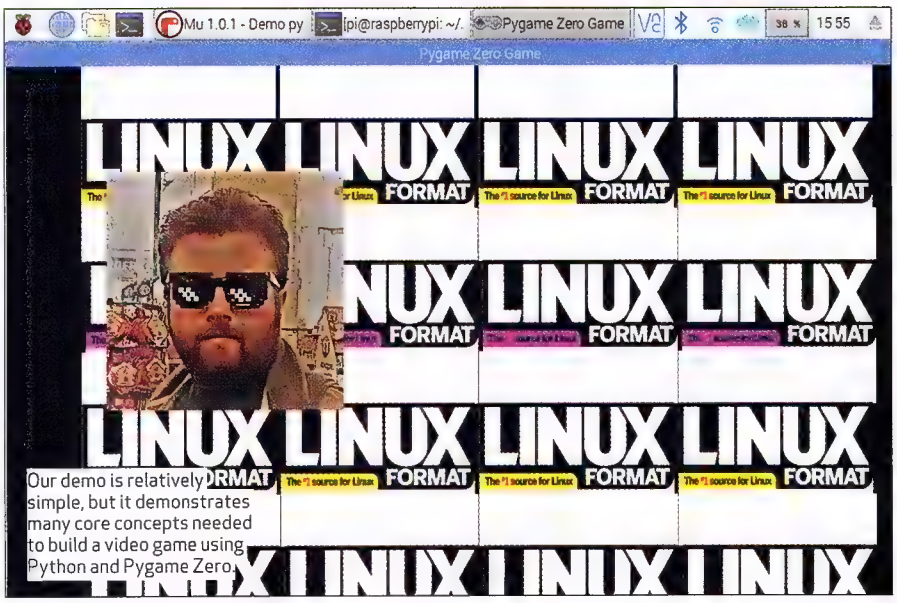
To write the code for this project we need to install Mu, a simple Python IDE for beginners. We install Mu because it's a great environment in which we can easily write the Pygame Zero code.

To install, we need to open a terminal and type:

```
$ sudo apt update && sudo apt install mu-editor
```

With Mu installed you can find the application in the Programming menu. Open Mu and in the top left look for the Mode button. Click this and select 'Pygame Zero'.

Before we get into the code, note that in your home directory (/home/pi/) there'll be a directory called /mu_code containing directories that will be used to store the images, sounds and music for this project. Sprites and background images should go into the /images directory, sound effects into /sounds and any music into /music. Pygame Zero requires these files in the right place so that we can easily reference them in the project.



Our demo is relatively simple, but it demonstrates many core concepts needed to build a video game using Python and Pygame Zero.

START CODING

We start the code by importing a single library and this is the random integer function from the random library. We shall use this to randomly place our sprite:

```
from random import randint
```

Sprites are objects that move on a screen, for example Mario is a sprite in 8- or 16-bit *Mario* games. Pygame Zero calls sprites "Actors" and so to use a sprite we need to call the actor by their name. This relates to the name of an image in our Images directory. In this case we used "biglesp" but you should change this to your chosen sprite:

```
sprite = Actor('biglesp')
```

Using the `randint` function we can specify a random place for our sprite to start. In this case we ensure that the sprite is 10 pixels from the screen edge, and then use `randint` to randomly appear at a different height in the window. We use `0,200` as a range, but change this to reflect the height of your window:

```
sprite.topright = 10, randint(0,200)
```

Talking of windows, the next two variables control the width and height of the window and are based on the dimensions of the background image. Ensure that these are changed to match the image that you wish to use (for our demo, we've used the logo of *Linux Format*, one of *APC*'s UK sister magazines):

```
WIDTH = 1096
HEIGHT = 739
```

Next we tell Pygame where to find our background music. This is an OGG file in the Music directory. Using the `play() function` without passing a number means that the music will loop forever:

```
music.play('bg_music.ogg')
```

The first function we create is for our screen. This will create the window, clear the contents of the window, then place our background image in the top left (0,0) of the window. This is then drawn on the screen:

```
def draw():
    screen.clear()
    screen.blit('lxf_group.png',(0,0))
    sprite.draw()
```

The next function is called `update` and it's used to update our sprite (actor) so that it can scroll left to right in the window:

```
def update():
    sprite.left += 2
```

Still inside the function, let's add some interactivity using a series of conditional statements that will check to see if we've pressed a key on the keyboard. The first two statements control the height of the sprite in the window. This uses the W key to move upwards and the S key to move downwards:

```
    if keyboard[keys.W]:
        sprite.y -=1
    elif keyboard[keys.S]:
        sprite.y += 1
```

We then use the A and D keys to rotate the sprite by changing the angle of the sprite:

```
    elif keyboard[keys.A]:
        sprite.angle += 1
    elif keyboard[keys.D]:
        sprite.angle -= 1
```

The next two conditions to assess are firstly a test to see if the sprite has gone beyond the boundary of the window. If that's the case then the sprite will move back to the far left

using the `sprite.right` object. The last condition to test checks if the user has pressed the Esc key to close or quit the window:

```
    if sprite.left > WIDTH:
        sprite.right = 0
    if keyboard[keys.
ESCAPE]:
        quit()
```

CLICK THE SPRITE

The next function is designed to react to mouse input. If our sprite is clicked using the mouse, then it's "collided" with the pointer and so it'll print to the Python shell. Then it will call the function `set_sprite_click()`, which we shall create later. But if the sprite isn't touched then it prints another message to the Python shell. These print statements are optional, but are handy when debugging:

```
def on_mouse_down(pos):
    if sprite.
collidepoint(pos):
        print("Got me!")
        set_sprite_click()
    else:
        print("You can't
catch me!")
```

Next, we create the function that will be called when the sprite's been clicked. In this function we swap the sprite image for an inverse of the original image, which gives us visual feedback to show that the sprite has been clicked. For audio feedback we use the Pygame sounds class to play a cowbell sound effect. The last line in the function is a callback to a function that will return our sprite to `normal` after one second. We use Pygame's `clock schedule` function because it won't block the code from running, unlike using the time library. Using `clock schedule` enables the rest of the code to carry on while we wait for the sprite to return to normal:

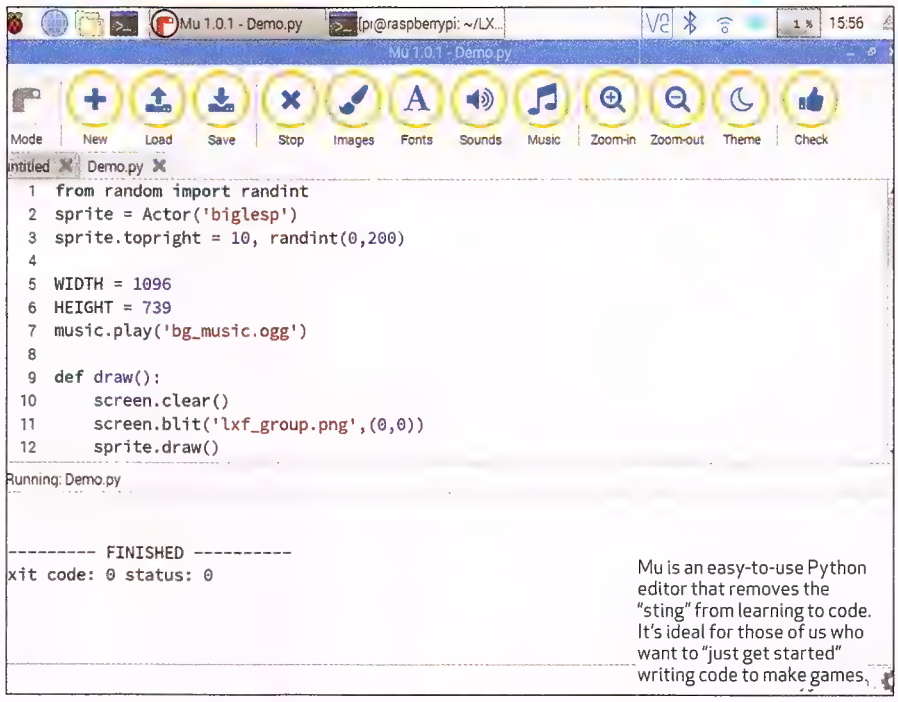
```
def set_sprite_click():
    sprite.image = 'biglesp_
inv'
    sounds.cowbell.play()
    clock.schedule_
unique(set_sprite_normal, 1.0)
```

The final function resets the sprite to normal after it's been clicked:

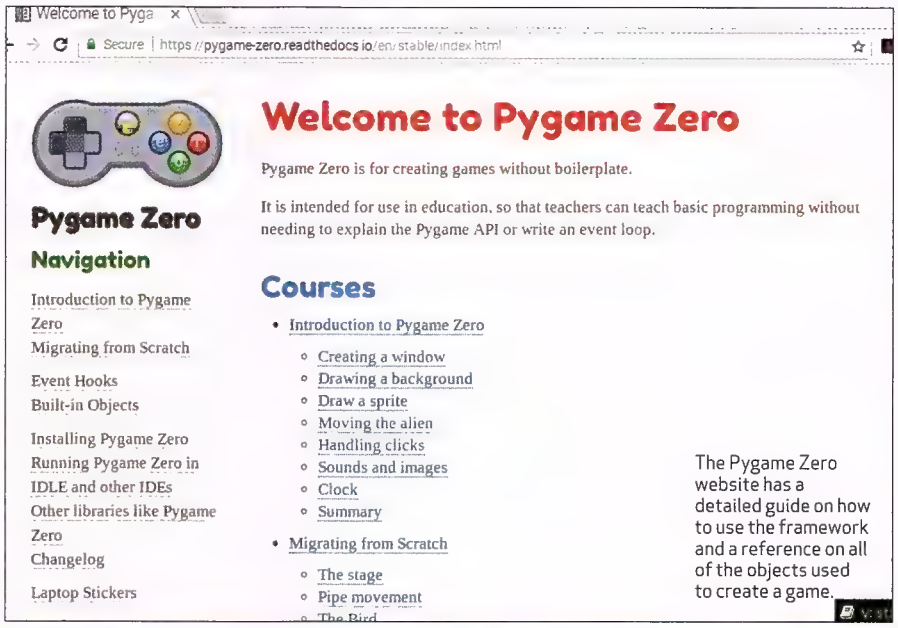
```
def set_sprite_normal():
    sprite.image = 'biglesp'
```

So now we can save the code as Demo.py and then click Play to run the code. We should see a new window appear, and our demo music should be playing.

Pygame Zero is an impressive introduction to game development using Python and this quick project will hopefully have whetted your appetite enough to learn more and via its website. Do just that by visiting **tinyurl.com/apc466-pygame** today!



Mu is an easy-to-use Python editor that removes the "sting" from learning to code. It's ideal for those of us who want to "just get started" writing code to make games.



The Pygame Zero website has a detailed guide on how to use the framework and a reference on all of the objects used to create a game.

Creating the demo's assets

Our demo uses two images and one audio file. But where can we get them from?

Well, if we need images we can use the artwork at **openclipart.org** because all of the images there are royalty free and in the public domain. For audio, take a trip to YouTube, which has a selection of copyright-free music tracks and sound effects. Go to **www.youtube.com/audiolibrary/music** to see the vast selection on offer. You can also visit **https://cchits.net**, which is a curated list of the top 15 Creative Commons music tracks.

If you want to create your own assets from scratch, then consider using Inkscape (**https://inkscape.org**) or Gimp (**www.gimp.org**) to create images. Inkscape is a vector image editor and is excellent for accurate drawings. Gimp is similar to Photoshop and can be used to enhance an existing image.

For music, we found that Sonic Pi (**https://sonic-pi.net**), a music editor that uses code to make music, is a great place to start if you want to compose a simple tune. You can then output the audio and edit it with Audacity (**www.audacityteam.org**) to trim and add effects to the loop.

Android Video Playback Masterclass

Understand the ins and outs of mobile video playback and make the most of your Android phone or tablet. Darren Yates explains.

For many of us, the only thing we need to know about mobile video playback is how to install the Netflix or Stan apps. But while binge-watching your favourite shows is all well and good, it's not the only way to watch video content on your mobile device. Whether you store your content on your phone, PC or local network-attached storage (NAS), there are plenty of tricks to optimising video playback on a portable device.

ASSUMING THE BASICS

We won't cover the basics here, we'll just assume you understand that a video file consists of three key elements – a file container format, a video data stream compressed using a video compression format or 'codec', and a similar separate stream for audio. You probably even already know popular file containers such as AVI and MP4, as well as video codecs like H.264 and audio codecs including MP3 and FLAC.

HARDWARE AND SOFTWARE-DECODING

Most video formats are decoded by the CPU in a typical PC, but since that CPU also has billions of clock cycles per second to play with, it's usually not an issue. In mobile devices, however, it's a different story. CPUs are incredibly versatile, but that versatility also makes them less efficient – and high CPU usage isn't a great recipe for long battery life. Android has native support for a number of video and audio codecs, meaning there's no need to install extra software – you can just tap your video file in a file manager and Android does the rest. You can read the list of natively-supported audio and video codecs online at Android's developer website (**tinyurl.com/apc466-codec**). While the list of audio codecs is pretty decent, the video codec list is a bit more spartan, with just H.264, H.264, MPEG-4 SP and Google's own VP8 and VP9 formats. The most notable omission from this list is MPEG-2, the format used for DVDs and DVB-T TV broadcasts.

Now you can pick up what's missing when you install a decent video player from Google Play such as MX Player (**tinyurl.com/apc466-MXplayer**). It has an excellent additional video codec pack you install separately that adds in almost everything Android typically lacks. That said, the latest update removes Dolby AC3 audio support, reportedly due to licensing issues. VLC for Android (**tinyurl.com/apc466-VLC**) is another must-have player.

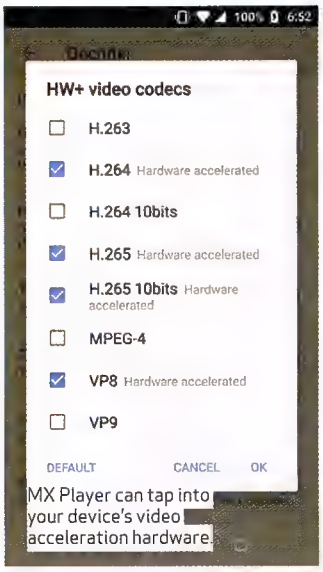
But whether or not Android supports the video codecs or not is only half the solution – the other half is how the phone implements those codecs. This is where 'hardware video acceleration' makes the difference. While a PC generally decodes video streams via the CPU, most phones incorporate specific hardware for the job. The reason for this is that a dedicated ASIC (Application-Specific Integrated Circuit) solution is far more power-efficient (and usually faster) than a general-purpose CPU. This translates not only into better battery life, but leaves your phone's CPU available for other tasks. So the trick here is if you want to maximise your phone's battery life during video playback, choose video files that use a codec your phone supports with hardware acceleration.

Which codecs are these? Typically, most Android phones going back to Android 5.x/Lollipop will have hardware-accelerated for H.264 and VP8, but it depends largely on the SoC (System on a Chip) processor in your device. For example, Qualcomm's Snapdragon 412 does H.264 and VP8 in hardware, but added H.265/HEVC acceleration into the Snapdragon 430. The new Qualcomm 8cx we talked about in the last issue (APC #465 page 101) includes hardware decoding for VP9.

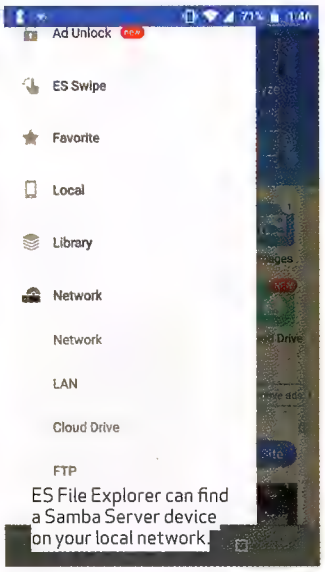
HDR SUPPORT

If you think high-Dynamic Range (HDR) video is only for PCs, think again. Google added HDR support into

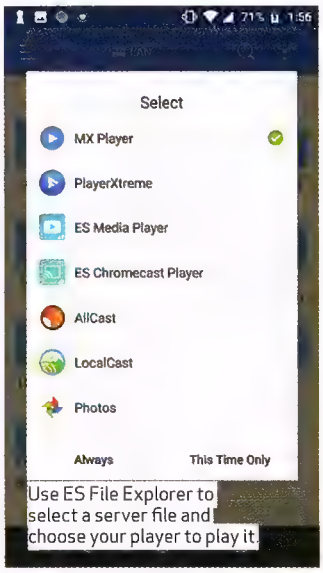
ES File Explorer will list the IP address of your old device Samba Server.



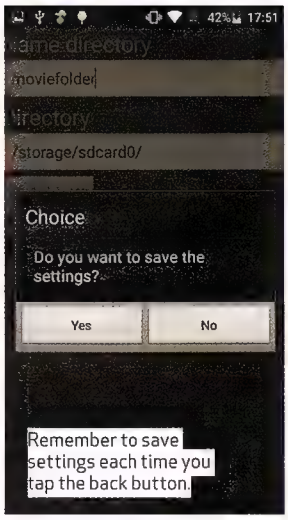
MX Player can tap into your device's video acceleration hardware.

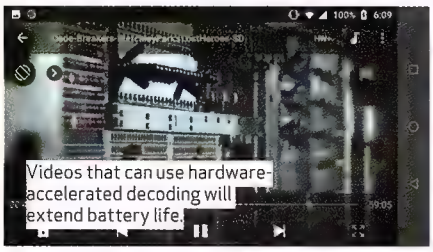


ES File Explorer can find a Samba Server device on your local network.



Use ES File Explorer to select a server file and choose your player to play it.





Android beginning with Android 7.0/Nougat. However, it's only supported when playback occurs via 'tunnelled mode'. This basically means that the device rendering the image has to have built-in HDR hardware support for it to work, rather than just software-decoding. Again, you'll need to check your phone for this support, but in general, Android 7.0 will handle the two most popular options – Dolby-Vision and HDR10 – along with Google's two VP9-based alternatives, VP9-HLG and the HDR10-similar VP9-PQ. If you want to use Google's Chromecast to play HDR video, you'll need Chromecast Ultra as the standard version doesn't support it.

MULTI-CHANNEL AUDIO

Beyond the stereo headphones, most Android mobile devices aren't equipped to output more than two channels of audio. However, again, most will support what's known as 'USB audio pass-through', which essentially just means passing the data through to an external audio decoder. Android devices have supported USB audio since Android 5.0/Lollipop, but more practically since 6.0/Marshmallow. However, your device will also need a USB-OTG port – this looks like a standard MicroUSB port, but can double-time as a USB host port to connect up to an external device, such as a USB sound card. Another alternative, if available on your device, is to use Miracast or DLNA and wirelessly send the audio-video data stream to a home theatre setup and big-screen TV.

MAXIMISING BATTERY LIFE

We've looked at how hardware-accelerated decoding can reduce your Android device's power demands, but that's not the only thing you can do to make your device battery go the distance. The frame size of your video file (the number of pixels in each image) also seriously affects battery life. For example, you can get an extra 60-90 minutes' run-time by playing 720p (1280x720-pixel) video instead of 1080p (1920x1080-pixel) files – and that's even with hardware acceleration. The reason is pretty simple – video at 25 frames per second (fps) has to display a frame every 40 milliseconds. That's non-negotiable. But if that frame has two-million pixels (1080p) to decode rather than just one-million (720p), the decoder must work twice as fast.

Your mobile device might even be able to display 4K video, but really, do you need that much resolution on a small device? I'd hazard a guess you'd be hard-pressed to tell the difference between 720p and 1080p on most five-inch phones, so why play 1080p files if 720p versions are available?

The same issue also applies when you take into account video frame rates. Video is just a series of still images displayed at a constant rate per second, so a video with a frame rate of 60fps will shorten your device battery life by roughly a quarter compared with the same video at 30fps.

Going back to the issue of software versus hardware decoding, this is where your choice of video codec can also carve up your device's battery life. For example, playing back a 1080p video using a software-based HEVC/H.265 codec option will likely give you no more than half the battery run-time compared with using hardware-accelerated H.264 decoding at the same frame size and rate. Software-based HEVC (high-efficiency video coding) is incredibly efficient in terms of the file storage required for a given level of video quality, but it relies even more heavily on CPU decoding, pushing up the CPU usage and power demands. This is why H.264 is usually the better option for older devices without HEVC hardware – if you rely on CPU rather than hardware decoding, you can start waving your battery life goodbye.

PLAYBACK VIA NAS

While local playback requires decent amounts of on-board or microSD card storage, the other practical option is setting up network-attached storage (NAS) and watching over Wi-Fi. VLC for Android can play videos over Wi-Fi, so too ES File Explorer, either through its own player, or a third-party player already on your device.

The NAS doesn't need to be fancy either – an old PC or laptop will do, even an old Android device with storage and/or a USB-OTG port. Here's how this works.

First, install the free Samba Server app from Google Play (**tinyurl.com/apc466-samba**) onto your old device and ES File Explorer (**tinyurl.com/apc466-ES**) on your playback device. Launch Samba Server. Next, press the Add button, select SMB Server and enter a server name on the new screen. Scroll down and tap the four 'Get random port' boxes – these select new ports to provide connection to your playback device. After that, tap the Roots button top-right, click on the Add button, press the browse button, choose your video folder to share as the new 'home' folder and give it a name in the Name Directory box. When you're done, press the back button, tap Yes to save changes. Press the back button again, press Yes to save settings and finally click the 'Start' button to start the SMB server.

Now, on your playback device, launch ES File Explorer, press the hamburger button (top-left), select Network, choose Network again in the sublist, hit the blue Scan button and a new icon with your old phone's IP address should appear. Tap on it and navigate to your folder, select a movie and choose a player option. Sit back and enjoy.

The beauty of this method is that no root access is required on any device and all apps are free. The downside is that we couldn't get Samba Server to work on anything newer than Android 5.x/Lollipop.

WHO'S GOT THE CHIPS?

With even budget Android devices now sporting four-core CPUs and hardware video acceleration, playing your own content – wherever it's stored – is pretty easy to do. Choose the right video specs and you'll make your phone's battery last even longer. ■

Python for Machine Learning Part 2: Loops & Functions

Darren Yates continues this new Python series with a look at how to use loops and functions in your code.

In the last issue (APC #465), we introduced you to the world's favourite programming language, looking at variables, printing to the screen and using the if-else statement. This month, we'll look at the next set of building blocks called loops and functions. Python is popular because it's extensible – you can define new code blocks called 'functions' and create new functionality. Loops are also vital to coding because they allow you to repeat the execution of lines of code without having to write them over and over.

GET THE SOFTWARE

Just briefly, you need at least Python version 3.6 (3.7 is fine too) for this series – we'll use the Windows version for convenience, but there are also Linux and macOS versions as well. Download it free from the Python.org website at **python.org/downloads**. As we go, we'll need other tools and functions, but we'll cover that when we come to it.

So get the software, install it and launch the IDLE integrated development environment.

I WILL STOP TALKING IN CLASS

At the start of every episode of *The Simpsons*, there's always a short sequence of Bart Simpson writing lines on the blackboard. I vaguely remember having to do this at school myself once. However, I wish now I'd been clever enough that instead of writing 100 times 'I will stop talking in class' or whatever it was, to write it as software code using BASIC (because every kid with a home computer in the early '80s learned BASIC).

Here, in Python, it's even easier, so rather than writing 100 lines, we just write two:

```
for textline in range(100):
    print("I will stop
talking in class")
```

The first line here initiates what's called a 'for-loop'. The keyword 'for' is the dead giveaway; the variable 'textline' will hold in turn each of the values that come after the 'in' keyword (by the way, you can use any valid variable name here, as long as it starts with an alpha-character and isn't a Python keyword like 'print').

Following the 'in' keyword here is 'range(100)'. This is Python's way of creating a series of integers (whole numbers) from 0 to 99. So our for-loop takes each integer in turn and stores it in the variable 'textline'. Since we have 100 integers, '0' to '99', our for-loop will run exactly 100 times. At the end of this line is a colon (:) – that means the indented code that follows belongs to this for-loop and is executed once for each run of the loop. If you remember from last time, indenting is key in Python – you must get this right, otherwise your code won't function the way you expect.

The indented code that follows the colon here is a single print statement that prints 'I will stop talking in class'. Notice that we don't actually use the value stored in 'textline' for anything – in this instance, it's just a way for us to count up to 100. Finally, what we end up with is 100 lines of the text 'I will stop talking in class' and a smug face on my 12-year old self (likely followed by lunch-time detention and 200 lines).

What does this all have to do with machine learning? Most data you'll analyse comes as a two-dimensional spreadsheet-like table with rows and columns. For-loops are a common way of working through or 'iterating' over that data to make calculations (remember: machine learning involves huge numbers of mostly simple mathematical calculations). For-loops allow you to add up columns, calculate averages and so on.

WHILE WE'RE ON IT...

Most words on their own are just words. It's when you string them together that you create meaning. The same is true for coding – in reality, you only need a few key concepts and from there, you can create different applications by how you string

```
binaryguess.py - C:/Users/Darren/Documents/2019 Python code/2/binaryguess.py (3.7.1)
total = 0
bit = 7
print("Pick a number between 0 and 255, I'll find it inside eight attempts."
while bit >= 0:
    value = pow(2,bit)
    answer = input('Is your number greater than or equal to '+ \
                   str(total+value)+' (y/n)? ')
    if (answer == 'y'): total += value
    bit -= 1
print("Your number is", total, "!")
```

Guess any number between 0 and 255 inside eight attempts using a while-loop.

```
Python 3.7.1 Shell
thon 3.7.1 (v3.7.1:260ec2c36a, Oct 20 2018, 14:57:15) [MSC v.1915 64 bit (AMD
] on win32
pe "help", "copyright", "credits" or "license()" for more information.
>>>
= RESTART: C:/Users/Darren/Documents/2019 Python code/2/functionaverage.py ==
e average is 71.0
e average is 83.75
e average is 191.375
>>>
```

Our 'average' function makes calculating averages pretty simple

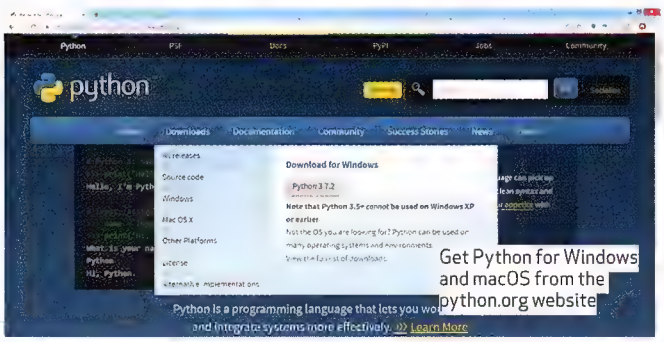
```
functionaverage.py - C:/Users/Darren/Documents/2019 Python code/2/functionaverage.py (3.7.1)
def average(list):
    avg = sum(list) / len(list)
    return avg

list_of_numbers = [23, 14, 136, 87, 95]
average_of_numbers = average(list_of_numbers)
print("The average is", average_of_numbers)

new_list = [45, 3, 66, 92, 25, 310, 44, 85]
average_of_numbers = average(new_list)
print("The average is", average_of_numbers)

yet_another_list = [445, 113, 375, 58, 9, 127, 334, 7
average_of_numbers = average(yet_another_list)
print("The average is", average_of_numbers)
```

Creating a function to calculate averages can make your code very portable.



Get Python for Windows and macOS from the python.org website

```
Python 3.7.1 (v3.7.1:260ec2c36a, Oct 20 2018, 14:57:15) [MSC v.1915 64 bit (AMD
4)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>> for textline in range(100):
        print("I will stop talking in class")

I will stop talking in class
I will stop talking in class
I will stop talking in class
I will stop talking in class
I will stop talking in class
I will stop talking in class
I will stop talking in class
I will stop talking in class
I will stop talking in class
I will stop talking in class
```

I wish I knew how to do this back at school...

```
Python 3.7.1 (v3.7.1:260ec2c36a, Oct 20 2018, 14:57:15) [MSC v.1915 64 bit (AMD6
4)] on win32
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==== RESTART: C:/Users/Darren/Documents/2019 Python code/2/binaryguess.py ====
Pick a number between 0 and 255, I'll find it inside eight attempts.
Is your number greater than or equal to 128 (y/n)? n
Is your number greater than or equal to 64 (y/n)? n
Is your number greater than or equal to 32 (y/n)? y
Is your number greater than or equal to 48 (y/n)? y
Is your number greater than or equal to 56 (y/n)? y
Is your number greater than or equal to 60 (y/n)? n
Is your number greater than or equal to 58 (y/n)? n
Is your number greater than or equal to 57 (y/n)? n
Your number is 56 !
>>> |
```

Binary search allows our code to find any 8-bit number in eight attempts.

programming statements together. Another type of loop Python supports is the 'while-loop'. For-loops are ideal when you know how many times you want the loop-code to execute. When you need the code to keep running until a value or event changes (and you often have no idea how many times it needs to run), that's when a while-loop comes into play – it keeps running while its condition remains true.

I love how binary numbers work because they're the basics behind digital electronics and the whole computer revolution. So, we're going to use a while-loop to write a number-guessing game with a twist – pick any number between 0 and 255 and our code will find it in eight attempts by asking you a series of simple 'yes' or 'no' questions:

```
total = 0
bit = 7
print("Pick a number between 0 and 255, I'll find it inside eight attempts.")
while bit >= 0:
    value = pow(2,bit)
    answer = input('Is your number greater than or equal to '+ \
str(total+value)+' (y/n)? ')
    if (answer == 'y'): total += value
    bit -= 1
print("Your number is", total, "!")
```

Our binary-search guessing game works by continually subdividing the search pattern into smaller binary sections or 'bits', starting at bit 7 (the eighth bit), which in decimal is 128. We use Python's built-in 'pow' (power) function to raise the number two to the power of the value of 'bit', which initially starts at '7'. Depending on the user's answer, we add the decimal value to 'total' if they answer yes, then subtract one from the 'bit' value and while that value remains greater than or equal to zero, we keep looping. If you look at the series of 'y' and 'n' user answers that result, convert the 'y's and 'n's to '1's and '0's, what you actually get is the binary value of your chosen number. For example, 56 becomes 'nnyyynnn', which in binary, is 00111000. That's pretty cool.

THE FUNCTION CENTRE

Combine everything we've covered so far to now and you already have most of the basic tools you need to start writing your own code. However, there's one extra ingredient that you'll use constantly while machine-learning, and that's functions. If a for-loop allows you to repeat a chunk of code a number of times, a function allows you to define a chunk of code just by a name. We mentioned before about using for-loops to calculate averages, so let's try it:

```
list_of_numbers = [23, 14, 136, 87, 95]
count = 0
total = 0
for number in list_of_numbers:
 count = count + 1
 total = total + number
print("Average of numbers is", (total/count))
```

The first line creates a 'list' of five numbers using the square brackets. After that, we have two variables needed to calculate the average. The first, called 'count', counts up the number of numbers in the list; the second, 'total', totals up the numbers (remember, average is the total value of the numbers divided by the number of numbers). Next, is the for-loop and here, we store each list number in turn from the 'list_of_numbers' list in the variable 'number'. During each loop, we increment the 'count' value and add the 'number' value to the 'total' variable. Then, when we've looped over all five numbers, we print the result, dividing the value of the 'total' variable by the value of the 'count' variable.

This code works, but frankly, it's clunky, especially if you have to calculate an average more than once (it's called 'veryaverage.py' in the source code pack).

Here's a better way, using a function:

```
def average(list):
 avg = sum(list)/len(list)
 return avg
```

The 'def' keyword begins the definition of our function called 'average'. It takes in a parameter called 'list', which is a list of numbers like we had before. Notice the colon at the end? This defines the start of the function code, which here, consists of two indented lines of code. The first uses the built-in Python functions 'sum' and 'len' (length) and they do what our for-loop did originally – 'sum' totals the numbers in the list, while 'len' returns the number of numbers in the list. This concept of 'returning a value' from a function is important because that's what functions normally do – they take an input of some description, process it and return an output. Here, we return the value stored in the variable 'avg'. Once the function is defined, we can use it like this:

```
list_of_numbers = [23, 14, 136, 87, 95]
average_of_numbers = average(list_of_numbers)
print("The average is", average_of_numbers)
```

Functions allow you to create 'reusable' code – any time you want to call a function, you simply call the function name, give it the data it needs and it will return the processed output. We could've used the sum() and len() functions before, but creating your own functions makes it easier to keep track of your code and reduce errors.

Get this because machine-learning – and really, almost all coding in general – is all about functions. Functions appear in other programming languages as well, but often use different names – in Java, they're known as 'methods'.

GIVE IT A GO

You'll find the examples in our software pack this month – download it from the website at **apcmag.com/magstuff**. Load each file in turn into IDLE and press F5 to run the code. These two initial parts of our series amount to the world's shortest introduction to Python. However, you've got enough now to not only write your own simple Python programs, but also to tackle some introductory machine learning – and we'll get stuck into that in the next issue. In the meantime, muck around with this month's source code and learn to use functions, loops and if-statements. ■

Apex Legends is growing faster than Fortnite did

GOODNIGHT, *FORTNITE*?

Apex Legends, the free-to-play 60-player battle royale developed by Respawn and published by Electronic Arts, has already attracted 50 million players a month after launch. This shadows *Fortnite's* battle royale growth, which had barely reached that figure four months after its initial release.

Fortnite is inheriting Apex Legends' best ideas

NOTHING IS TRULY ORIGINAL.

And in light of the above report, Epic Games is cribbing some of the neatest touches from Respawn's shooter. At the time of writing, players had already found evidence of a new *Fortnite* respawn system, similar to the one pioneered in *Apex Legends*. Meanwhile, Respawn's clever communications system has since been implemented in *Fortnite*.

Publisher THQ Nordic attracts ire for disaster PR stunt

Pandering to the wrong crowd.

THQ Nordic, publisher of titles like *Darksiders 3*, *Pillars of Eternity II* and many more, came under fire last month when its PR department conducted an AMA ("Ask Me Anything") on an image board known for the alleged hosting of child pornography, as well as its active role in the 2016 Gamergate debacle. The company announced the AMA via its Twitter account on February 27, quickly drawing the ire of many in the industry – including employees of some of the studios the company publishes. Nonetheless, it proceeded.

While a meek apology followed shortly after by a PR spokesperson, THQ Nordic CEO Lars Wingefors issued an official apology the week after. "As Co-Founder and Group CEO of THQ Nordic AB, I take full responsibility for all of THQ Nordic GmbH's actions and communications," he wrote. "I have spent the past several days conducting an internal investigation into this matter. I assure you that every member of the organisation has learned from this past week's events."

Microsoft is edging further towards a seamless Xbox / Windows experience

BECAUSE AN XBOX IS REALLY JUST A FROZEN-IN-TIME PC.

It's no secret that Microsoft wants to combine its Xbox and Windows interests: every new Xbox game is cross-compatible with PC, usually share the same multiplayer servers, and the console now has limited mouse and keyboard support. But it doesn't look like the company intends to stop there: with rumours that its Game Pass service (basically Netflix for games) may be making the jump from Xbox One to PC, comes fresh evidence that Microsoft intends to allow all Xbox One compatible games to be playable on PC.

Evidence emerged recently for users of the Windows Insider program. During recent testing, **Thurrott.com** made note of the origin of a game made available for testing. It was downloadable from the Xbox servers rather than the Microsoft Store servers, suggesting that Microsoft's desktop gaming interests may soon exist on the same platform — seamlessly — as Xbox's.

Reggie Fils-Aime is retiring from Nintendo of America

Senior sales and marketing VP Doug Bowser will take his place.

Nintendo of America president and COO Reggie Fils-Aime, regarded by many as the amicable face of the company, is retiring. As the company announced today, Fils-Aime's last day will be April 15, 2019, after which senior marketing VP Doug Bowser will take his place.

"Nintendo owns a part of my heart forever," Fils-Aime said. "It's a part that is filled with gratitude – for the incredibly talented people I've worked with, for the opportunity to represent such a wonderful brand, and most of all, to feel like a member of the world's most positive and enduring gamer community. As I look forward to departing in both good health and good humour, this is not 'game over' for me, but instead 'leveling up' to more time with my wife, family and friends."

"Fresh evidence that Microsoft intends to allow all Xbox One compatible games to be playable on PC."

Pokemon Go team change feature has finally arrived

YOU CAN ONLY CHANGE TEAMS ONCE PER YEAR, BUT HEY, IT'S SOMETHING.

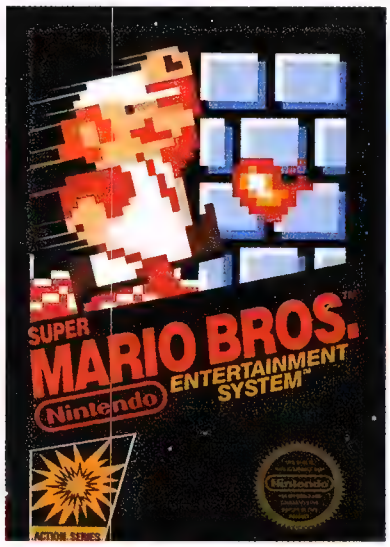
Pokemon Go has finally add the ability to change your team in a recent update, developer Niantic announced. You can purchase a Team Medallion for 1,000 Pokecoins (which can be earned for free or purchased with about US$10 of real money) from the shop which you can use to hop between Team Instinct, Team Mystic, or Team Valor. The catch is that you can only use a medallion once, and not only that, you can only buy one medallion per year — as in, every 365 actual days.

It'll be interesting to see how this update affects overall team composition. For as long as we can remember, Team Valor has been the most popular team, with Team Mystic slightly edging out Team Instinct. We still remember all the grief we got when we unwittingly joined Mystic after all our friends joined Valor. Not that we're bitter or anything; Articuno is still the bird for us. It's nice to have the option though, and we're sure plenty of players are looking for a change of pace.

Elder Scrolls 6 could launch as late as 2021

BOOKBREEZE.COM IS OPPOSING ZENIMAX'S REDFALL TRADEMARK.

Elder Scrolls 6 is a very, very long way away, and if this battle is anything to go by, then the ride to get there certainly isn't going to be an easy one. Youtuber Skullzi TV has spotted that **BookBreeze.com** is opposing the Redfall trademark application against ZeniMax Media (that is, the owners of Bethesda Game Studios) over its attempt to trademark the term 'Redfall'.



Sealed copy of Super Mario Bros. sells for $100,000

***SUPER MARIO BROS.* BREAKS ANOTHER RECORD BY REPRESENTING THE HIGHEST PRICE EVER PAID FOR A VIDEO GAME.**

How much would you be willing to pay for a video game? Most of us moan about forking out $89 for a new release, but how about $100,150? Perhaps that's a little above budget, but it's exactly what was recently paid for a sealed, first-run copy of *Super Mario Bros.* on the Nintendo Entertainment System. Traded at an collector's auction, the sale of the 34-year-old game apparently broke a world record for the largest sum of money ever paid for a single video game. ■

$99.95 | PC, XO, PS4 | WWW.CODEMASTERS.COM

Dirt Rally 2.0

Nothing will deliver several minutes at a time of ultra-intense concentration and satisfaction like this.

Back in 2004 the Last Great Rally Sim was released. *Richard Burns Rally* is a rare pinpoint of ultra-hardcore sim physics in a world of arcade rally games. Then, in 2015 Codemasters released *Dirt Rally* and it blew sim racers away with unexpected levels of sim authenticity. It was an immediate hit and, being far fresher than the ageing *Richard Burns*, the game reinvigorated interest in rally siming.

Codies has lifted the game with the successor, which is clearly pitched at the sim scene. You can tell, because the car physics feel terrifyingly, beautifully real. There's almost no OSD while you're driving, and tweaking around with the car setups yield appreciable and satisfying results.

As tricky as the handling is, it doesn't take long to get a good feel for it as confidence builds. After just an hour or two you'll be flinging the car around like a driving god, and that's what it's all about. Rally, by its essence, is a lonely endeavour – just you, the car and the track. And, the clock. It's the only kind of racing game where you never see other cars, thus, to be enjoyed properly it must be a totally zoned in experience when you only have yourself to beat. Yes, there are structured championships, but at the end of the day those only reward with a leaderboard ranking. To love this game, you need to love the purity of driving.

Pleasingly *Dirt Rally 2.0* is addictively moreish and the headroom to improve your skills and times feels unlimited. For sim racing fans like myself who dabble across many games, this is one to be perma-installed and played when the need to go totally mental in a forest or across a mountain beckons. When you're really on it the levels of focus and concentration required surpass any other kind of game, racing or otherwise, and that, my friends, is a huge reason why this is a good sim to own. There's not a single thought about the real world you'll have as you drive – it is escapist perfection and a major stress valve!

Out of the box the force feedback is extremely good, if a little soft. Some tweaking here will get things exactly right. My Fanatec CS 2.5 imparts superb car feel, with weight shift (so important in rallying!) beautifully done. You can also get by without a handbrake once your Scandinavian flicking Zen kicks in. Car setup options are as comprehensive as any hardcore sim and, pleasingly they, along with almost everything else you'll want to play with when not actually driving, is wrapped up in a delightfully simple UI.

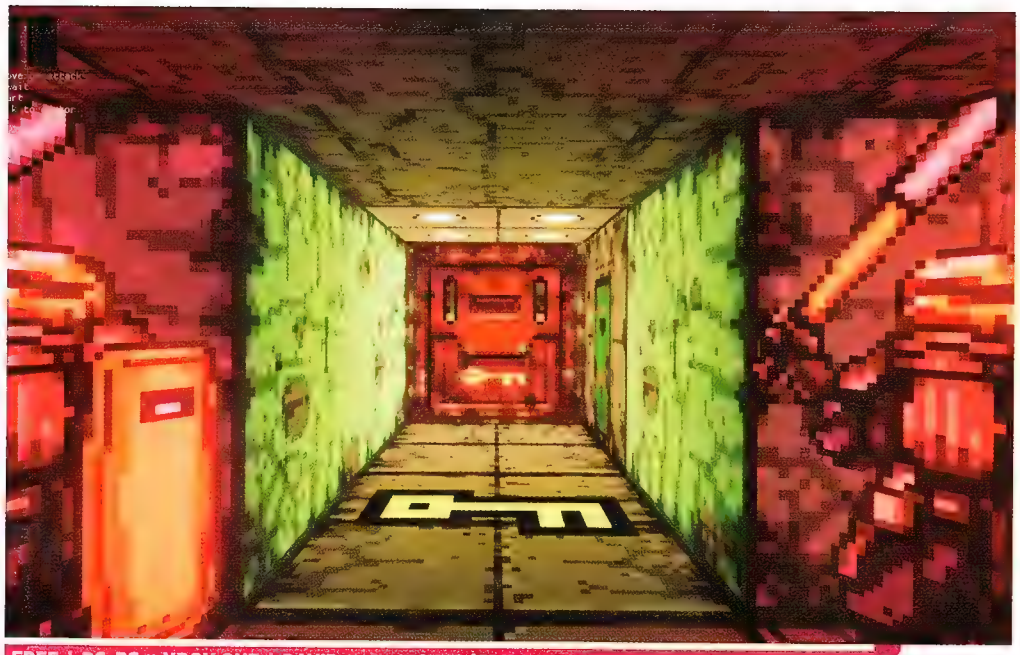
Fully modded-up, *Richard Burns* can still cut it, but here is a new game with new tech that delivers everything a rally simhead will adore. Good job, Codemasters, for this is the new king of rallying ■

Ben Mansill

Verdict

Sumptuous physics, gorgeous engine sounds and decent graphics add up to make this a winner.

★★★★½



FREE | PC, PS4, XBOX ONE | DAVID20321.ITCH.IO/GRIDLOCK

Gridlock

A dungeon crawler of the classic variety.

Gridlock takes place in a cyberpunk city, after wrong-'uns have dognapped your pet, leaving you to infiltrate their lair, batter everyone and rescue your pooch. That doesn't actually happen, I'm sorry to reveal, as the developers only found time to include one level.

Gridlock is a crawl that feels just lovely to control, with a rewarding sense of heft to the strictly grid-locked movement. Combat, too, feels impactful, even if it is fairly basic, lacking any verbs other than 'bash', an interaction you achieve by rubbing up against your enemies, roguelike style.

It helps that this is a particularly attractive game, its pixel art sprites and textures enhanced with some sophisticated lighting effects. This is a world that looks satisfyingly chunky and gritty, and rather a lot like *System Shock's*, but with added bursts of blinding neon to cloud your retinas. I'd love to explore more of this city, which is why it's so disappointing that the game cuts out abruptly, with a simple text message informing the player that there is no more.

I get the feeling that the developers spent most of their week-long development time on the level editor, and little on the actual game, and if so, I'm tempted to say it was the right decision. It's a wonderfully robust tool that allows you to muck about with any of the included map files, and to build your own even as you're wandering around.

Not a fan of collecting keys, and then laboriously hoofing it back to a door to open it? Simply crack open the level editor and delete a couple of obstructing walls. Or even enemies, should they be foolish enough to get in your way. There's no clear delineation between the 'game' and 'editor' parts of *Gridlock*.

A few more authored levels would have gone down a treat, as would more complex battles that make use of, say, ranged weapons or abilities. It's a bit placeholder but this is a fascinating jam game, and a rock-solid foundation for something better to build upon. ■ Tom Sykes

Verdict

The end will sneak up on you sooner than you would like, but this is still a great dungeon crawler.

★★★½☆

Galactic Center for Etymological Research

Word puzzles in space.

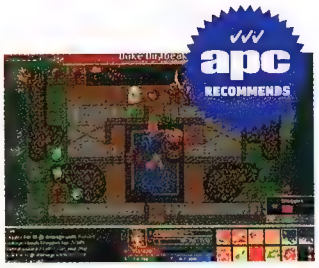
FREE | PC
TINYURL.COM/APC466-GAL

While *Galactic Center* is nominally a game of space exploration, where you'll travel from sector to sector, charting planets and managing your fuel reserves, what you're really doing is shuffling letters around to conjure up new words. The 'fuel' thing is just a turn limit, throwing up a cute failure message after a certain number of wasted moves.

You begin on the planet Star, but by swapping the S and T around, you discover the planet Tsar. And so on and so on, until you've located every possible planet in a solar system, and you're warped to an even more challenging lexicographical environment. While *Galactic Center* starts simply, offering basic words that are easy to contort into new ones, it balloons in complexity. Even the addition of an extra letter is a big step up in difficulty.

A solid puzzle game is what this is, artfully made and expertly paced, and with an appealing space exploration layer drizzled over the top. It's not the next great puzzler, but it will make your brain happy for an afternoon or two. ■ Tom Sykes

★★★½☆



Tangledeep

Go down to the woods today and catch some friendly fungal toads.

FROM $14.99 | PC, SWITCH
WWW.TANGLEDEEP.COM

The quietly charming *Tangledeep* deserves your attention with its compelling combination of fast turn-based play, a *Diablo*-esque loot system and the ability to 'bank' items and cash for use by later characters.

Tangledeep is a fairly straightforward roguelike in play — pick a character from one of 12 classes and see how deep into the game's dungeons you can venture before that character carks it. These runs can be surprisingly lengthy however — up to 3-4 hours if you make it through to the end — meaning it's possible to become quite invested in your current character… at least initially. The designers soften the blow of permadeath with a gameworld that continues on, so with a bit of forethought you can store away useful items that will give your future characters a serious head start, making subsequent runs more efficient and letting you get to deeper levels and better loot that much quicker. If you're a fan of turn-based RPGs, don't let this disarmingly deep little gem pass you by. ■

Dan Gardiner

FROM $99.95 | PC, XO, PS4 | WWW.METROTHEGAME.COM

Metro Exodus

Out of the darkness.

This third entry in the first-person shooter series switches from a largely linear design to a more open-world approach, and continues the story of Artyom, survivor of the nuclear holocaust who, for the last 20 years, has managed to eke out the semblance of a life by sheltering in the network of train tunnels beneath the ruins of Moscow.

With *Exodus*, 4A Games has successfully taken the gorgeously-gritty environs and strong storytelling that were the hallmarks of the first two games and expanded the playing field, providing players with a series of larger areas that are presented in a similar style to last year's *Red Dead Redemption 2*. Riding a train that serves as a mobile home base, *Exodus* sees you move far beyond the cramped confines of the Moscow Metro to a series of new and expansive locales across Russia.

If you've played a previous *Metro* game, you'll know that both smarts and stealth are required when facing the world's monstrous mutants, skeezy bandits and religious or political fanatics. As before, you're armed only with a handful of janky weapons and a constant scarcity of ammo. This is most definitely not a game for the impatient, or anyone looking for a thrill-a-minute *Call of Duty* actionfest.

As with its forebears, it's also still a little janky and buggy — in our playthrough, we encountered a couple of dozen instances of oddness, such as sleeping enemies floating in midair a foot from their beds and being picked up by a flying enemy, only to be dropped through the 'floor' of the world. The game's English-language voice acting also feels like it could have used tighter direction — while the line delivery is certainly earnest, actors sometimes fail to hit the right emphasis and the result is a decidedly hammy, B-grade experience.

Those shortcomings thankfully don't detract from *Exodus's* core attractions: engrossing first-person sneaking through gritty, lavishly detailed environments. If that appeals, post-apocalyptic worlds don't come much better than this. ■

Dan Gardiner

Verdict

It may not be revolutionary, but *Exodus* takes the franchise from linear to open-world shooter.

FROM $28.95 | PC, PS4, SWITCH, XO | WWW.WARGROOVE.COM

Wargroove

How to get your *Advance Wars* back.

As a 'loving homage' to Nintendo Game Boy and DS series *Advance Wars*, *Wargroove* hews pretty closely to its inspiration. With cutesy pixelated graphics and near-identical lite tactics-strategy gameplay, if you enjoyed any of the *Advance Wars* series, you'll undoubtedly fall immediately in love with *Wargroove*, the new game from British *Starbound* dev Chucklefish.

With the last *Wars* game having appeared way back in 2008 on the Nintendo DS, it's been a veritable age since gamers last got to experience this kind of turn-based strategy gameplay – and as such, you can't really blame Chucklefish for sticking closely to that winning formula. As in *Wars*, you're put in charge of a small army in a series of asynchronous battles, where each side gets to move all their troops before the enemy, then has their turn. In each mission, victory is generally achieved by either killing the enemy commander or destroying their headquarters, and to do so you'll need to capture villages and recruit new troops, while the bad guys try to do the same.

Wargroove does add some welcome new elements to that recipe, such as supplanting the action to a sci-fi fantasy world with 'hero' characters who each have a unique special ability – their 'wargroove' – and a simple (and gently-humorous) story helps carry you through its lengthy single-player campaign. Chucklefish has carefully balanced the combat with a rock/paper/scissors design that means certain troop types have advantages and weaknesses against others, and each mission is something of a unique challenge that can often take a try or two (or in our case, five) to beat. The difficulty ramps up as you progress, and the constant addition of new troop types and varying maps does keep you on your toes.

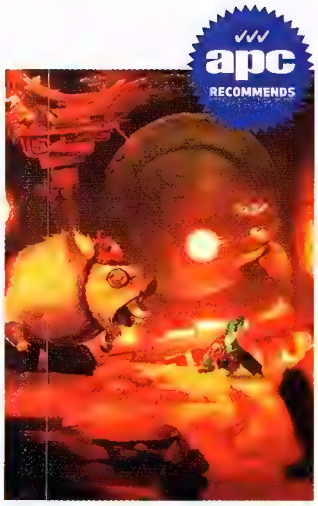
If you like turn-based strategy games in the slightest, *Wargroove* is one of 2019's must-plays. You may curse at the difficulty occasionally, but its gripping enough that you'll keep coming back for more, punishment regardless. ■

Dan Gardiner

Verdict

Anyone weaned on *Advanced Wars* should consider this lovingly crafted homage an essential play.

★★★★½



Unruly Heroes

Monks and magic.

$28.95 | NS, PC, PS4, XB
WWW.UNRULYHEROES.COM

From the newly formed Magic Design Studios, which is comprised largely of ex-Ubisoft developers, it's perhaps no surprise that *Unruly Heroes* shares a similar art style to that publisher's celebrated *Rayman Legends* (with some heavy inspiration from Frozenbyte's *Trine* series in the gameplay department). Based on the classic Chinese novel *Journey to the West*, *Unruly Heroes* is an action platformer that allows you to cycle through the game's four protagonists at any given time, each with their own fighting styles and abilities. Choosing the right character to proceed with becomes more important as the game progresses, with puzzle sections that require a particular character's speed or double-jump powers — something that's even more fun to figure out with friends in co-op mode. While *Unruly Heroes* exhibits a high level of polish, platforming isn't as precise as it could be, with plenty of mistimed jumps and accidental character deaths throughout the game's campaign. Thankfully, combat is very well-implemented, as is the rest of *Unruly Heroes'* presentation. ■

Stephen Lambrechts

★★★★☆

DEVELOPER: BLACK ISLE STUDIOS (BUT TOTALLY NOT THE A-TEAM) PERSONALITIES: TIM CAIN RELEASED: 1997 / 1998
NUTSHELL: EXPLODING HEADS, ATOMIC WARFARE, PROSTITUTION, HEAVY DRUG USE, MUTANT COWS, GIANT SCORPIONS, DIFFICULT MORAL CHOICES REGARDING DEVELOPMENTALLY-DELAYED FARM BOYS... AND THAT'S ALL JUST IN THE FIRST TWO HOURS.

War sometimes changes a little

As Interplay was gearing up to launch a series of AD&D RPGs that would set a new standard for depth and complexity, one small team sat in a back room indulging its bloodlust and love of obscure RPG systems. The result was a pair of games that have since been imitated at fabulous expense, though perhaps not bettered.

Each new version of *Fallout* feels more and more like cultural appropriation. No, wait, bear with me on this.

Back in the late 1990s, RPGs were a very particular kind of thing. Specifically, they were sword-and-sorcery fantasy, mostly sprite-fests on pre-rendered backgrounds. Back in 1997, *Ultima* was still king, though soon to have its crown wrestled away by the great Infinity Engine AD&D games like *Baldur's Gate* and *Icewind Dale*. Oh, and there was some soft-RPG action slasher called *Diablo*, but I don't think that ended up amounting to very much.

Those AD&D games though, I mention not entirely in passing, because the original *Fallout* was a response to and a rejection of the increasing D&D-ification of PC RPGs in the late 1990s. It dared to ask: what if role playing could be, you know, more like real life?

CLASS IS OVERRATED

Fallout lead Timothy Cain gave a famous and fascinating *Fallout* postmortem speech at GDC 2012, in which he tells the classic tale of a single developer working on his own engine in his spare time, resulting in a game so awesome its publisher was forced to commission a sequel even though the game was, in many ways, a bloody mess.

Part of what Cain, and the small team that grew around him, didn't like about RPGs at the time was the – shall we say – somewhat obvious path to victory. The better games let you be good and/or bad, but it was always obvious how to be each. Kill the dragon that's terrorising the town: good. Help the dragon burn down the town: bad.

The entire point of *Fallout* was to offer the players decisions where there was no obvious solution. A town is split in two by warring factions, but both leaders are terrible people. Which side do you support? What makes you make the decision? Is it whoever offers you the best reward? Is it how the result will affect another NPC?

This complexity of choice, and a lack of specific classes, was initially based on Steve Jackson Games' Generic Universal RolePlaying System.

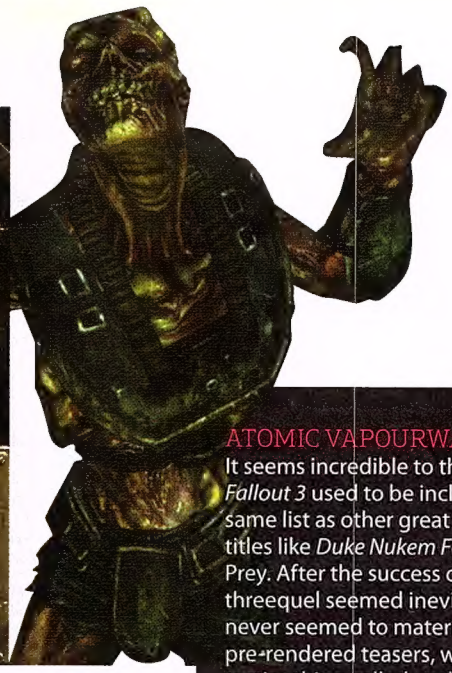
GURPS allows tabletop players to set their adventures in any possible genre or world. Even in impossible worlds. One of the key features is character Advantages and Disadvantages – these allowed players to assign points to different aspects of their character. Advantages cost points and give benefits, while Disadvantages limit the character but return points to be spent on other Advantages.

Also, GURPS included a huge – limited only by player imagination really – number of minor advantages (called Perks) and minor disadvantages (called Quirks) that added another layer to very detailed character customisation. *Fallout* players will of course recognise Perks – they're a core part of the SPECIAL RPG system. Advantages in *Fallout* are called Traits, and combine benefits and limitations in the one ability.

SQUEAMISH STEVE ISN'T SPECIAL

The reason these aren't called Advantages, and that GURPS doesn't get a mention in *Fallout* today (except in

The foundations the modern frachise are built upon.



ATOMIC VAPOURWARE!

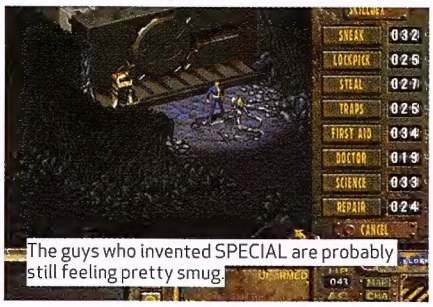
It seems incredible to think now, but *Fallout 3* used to be included on the same list as other great vapourware titles like *Duke Nukem Forever* and Prey. After the success of *Fallout 2*, a threequel seemed inevitable. Yet it never seemed to materialise. We got pre-rendered teasers, we got a weird tactics thing called, well, *Fallout Tactics: Brotherhood of Steel*. It took the collapse of Interplay and the intervention of [shudder] Bethesda to reinvigorate the franchise. Okay sure, maybe the following three games are incredibly fantastic RPGs in their own right that push the genre forward.

But that's not the point.

Or maybe it is the point.

Who knows.

That's how we did it in the olden days — none of this 3D, first person crap!



The guys who invented SPECIAL are probably still feeling pretty smug.

post mortems and Game Changers trips) is that Interplay lost the GURPS license partway through *Fallout's* development. Why? In short because Steve Jackson – the guy at least partly responsible for how pen-and-paper roleplaying was turning kids into Satanists or whatever – felt the game was too violent.

The team had to come up with its own system. We know it today as SPECIAL - Strength, Perception, Endurance, Charisma, Intelligence, Agility and Luck. We can only imagine the rounds of high-fiving that must have occurred at Interplay when they figured out that acronym. But then, Americans love them some clever acronyms.

Anyway, the end result was an RPG that wasn't like anything else the gaming world had ever seen. A classless real time (with a countdown clock) RPG with turn-based combat that was fast and fluid, set in an atompunk retro-future with an original aesthetic, full of real choices and dilemmas and, of course, a period-and-setting-appropriate dose of proper ultraviolence.

No wonder Interplay kept it relatively quiet until release. *Fallout* was everything the relatively safe and even (in comparison) twee megahits like the *Ultimas* (which Interplay was targeting) weren't. Interplay was gearing up to change the world with the super-deep and detailed *Baldur's Gate*, *Icewind Dale* and, of course, the definitive *Planescape: Torment*.

Each of these was an excellent RPG in its own right, and yet compared to *Fallout* there was just something... mainstream about them. They were, as I say, safe. Even the Nameless One from *Planescape: Torment* is a hero compared to a *Fallout* character.

BLOODY SUCCESS, CHEESY CHEATING

When *Fallout* was an unexpected, though still somewhat underground, success, Tim Cain and his team were given permission and cash to follow up with the far more sprawling and detailed *Fallout 2*, in 1998. Lest the gaming world think *Fallout* was a fluke of the year 1 BBG (Before *Baldur's Gate*), *Fallout 2* showed how wrong that was.

A personal favourite memory from *Fallout 2* was the infamous "Navarro Run". Because the game is so open-ended and the world so sprawling, it's possible – before doing anything more than the opening tutorial quest – to run straight down the map, reloading if you hit a particularly tough random encounter you can't escape from – to a military base. There, simply walk into the nearest barracks and there's a locker containing a full suit of high-level Power Armour. Whack it on and then stroll home in a leisurely fashion.

Since the game didn't do any of that "scaling enemy encounters to your current level of toughness" shenanigans, it made the entire first half laughably easy.

And yet it's tantamount to the skill of the developers and designers that, even with early power armour, the game is still incredibly fun.

Of course, there are purists who insist the Navarro Run is the worst kind of cheesing, because you're taking advantage of the game, or something.

But that's *Fallout 2* to a tee. A game that was so subversive, you could even subvert it's own subversion in a sort of meta-subversion.

LIAM NEESON ARE YOU KIDDING ME?

What's subversive about *New Vegas*? What's edgy about *Fallout 4*? They're just FPS/RPG hybrids that try too hard. They're the same as a dozen other games, just with a reasonably unique aesthetic.

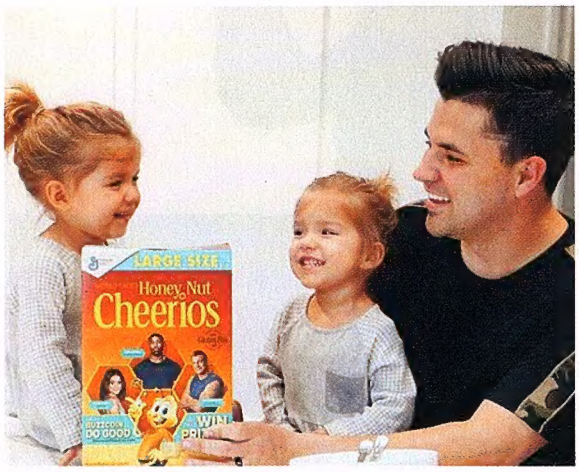
Playing the original games made you feel like you shouldn't be playing them. OMG, you thought, is this really in a videogame? Does it really say on the back of the box that you can get married and then pimp out your wife? Is there really a perk called "bloody mess"?

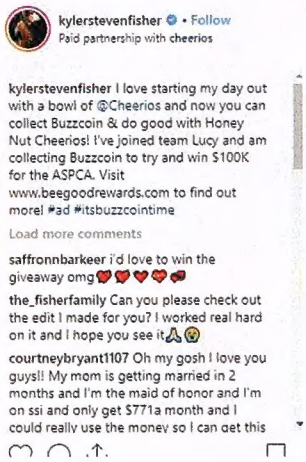
But these big-budget *Fallouts* of the 21st century are just too obviously the product of focus group testing and feedback. *Fallout* and *Fallout 2* were warts-and-all, seams-showing, occasionally-pointlessly-easy products of old-school QA. Get in the room, play it, tell us if it breaks. Oh it broke? Nah, that's not worth fixing, keep playing.

When Tim Cain and his team built *Fallout* they had no idea what they were doing. But they had vision. That's the exact opposite of how *Fallout 3* was built. My PC gaming cultural heritage is not your multi-million dollar FPS Liam Neeson paycheque. OK, it's still an awesome game. But never forget it owes so much to the original.

Anthony Fordham ■

» JOEL BURGESS REPORTS ON THE UNUSUAL SIDE OF TECH NEWS.

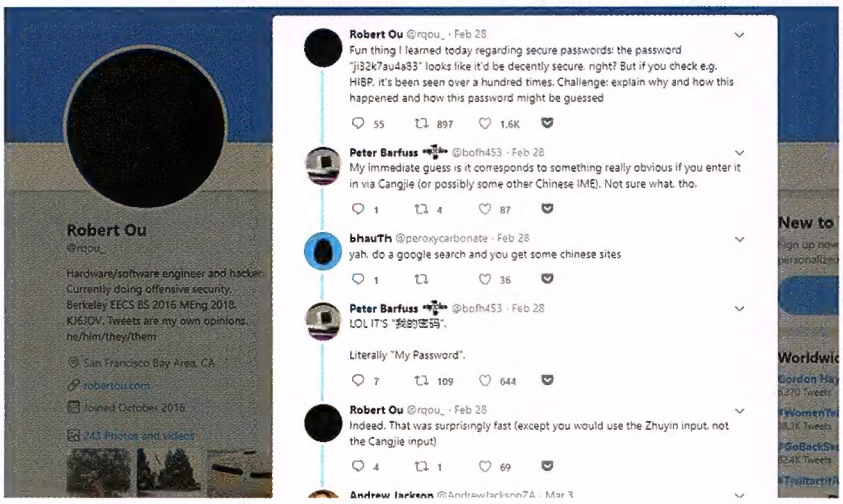




Unborn kidfluencer has 117,000 Instagram followers

Kidfluencers charging up to $20k for a sponsored Instagram post.

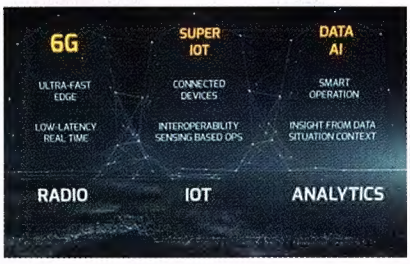
Today's most successful influencers grew up alongside the emerging concept of the 'social media personality', but to be successful in the future, influencers may have to start well before they've had a chance to grow up at all. Established 'Kidfluencers' like two-and-a-half year-old identical twins Taytum and Oakley Fisher already command lofty $10,000 - $20,000 premiums for sponsored posts directed at their 2.5 million Instagram followers, according to a New York Times interview with the twin's father Kyler Fisher. The latest addition to the Fisher family empire, Halston Blake Fisher, had over 117,000 followers on Instagram before he was born in March.



ji32k7au4a83 is not a good password

IT MIGHT LOOK SECURE, BUT IT'S ACTUALLY ONE OF THE WORST.

While you might expect this indecipherable jumble of letters and numbers to be something that a password manager would spit out at you as an idyllic password, ji32k7au4a83 has actually already appeared in 141 known data breaches according to haveibeenpwned.com. While 141 isn't quite as common as the 23.2 million times the password '123456' has been seen, it was enough for a San Francisco software engineer Robert Ou to use the Twitterverse to try and work out its origins. According to responders the code spells out My Password in Mandarin when using a Taiwanese keyboard with a Zhuyn Fuhao layout.



Trump implores American companies to 'step up' efforts on 6G telecom infrastructure

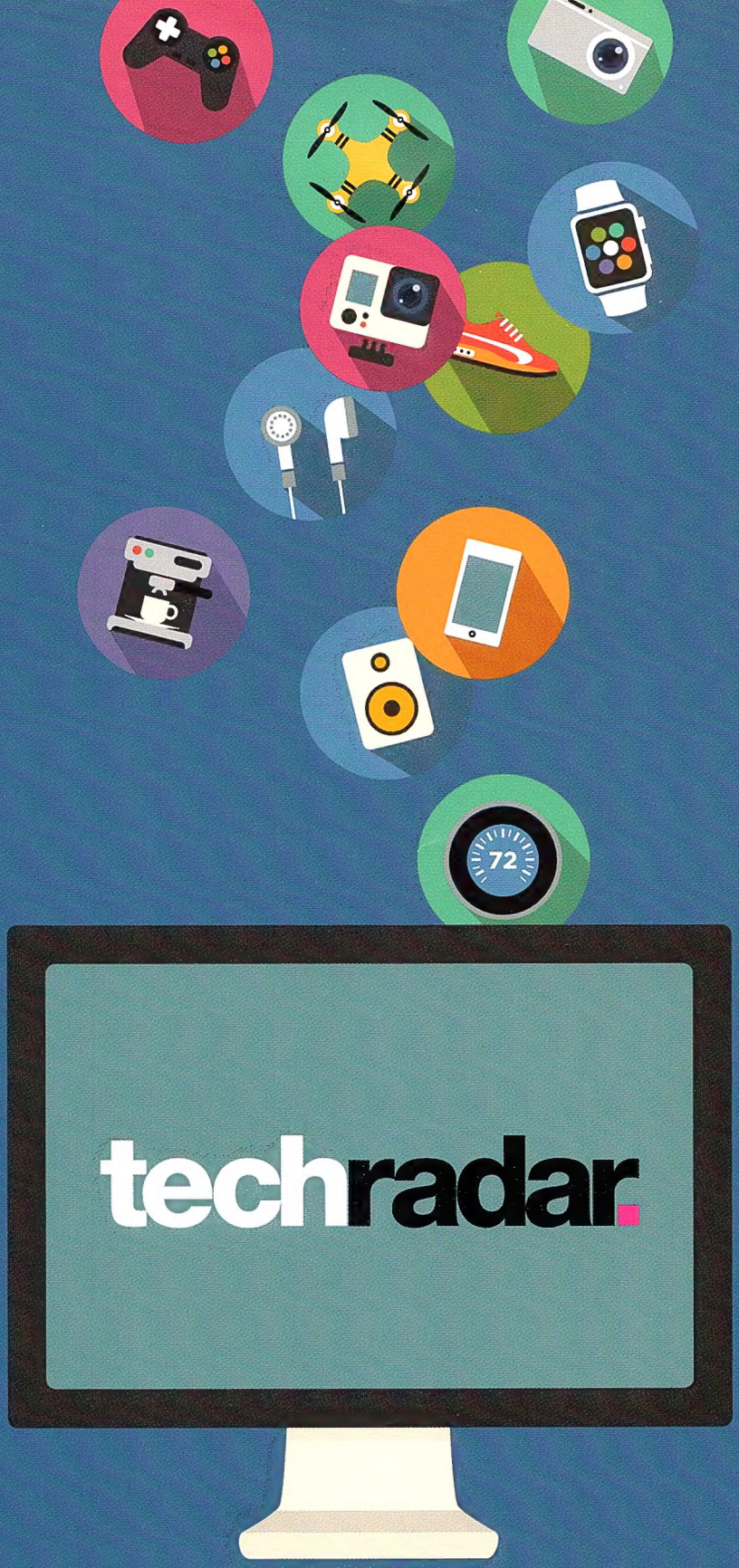
TRUMP INVENTS FICTIONAL TECHNOLOGY TO MAINTAIN AN EDGE.

The fifth generation of telecom infrastructure known as 5G is only just becoming available in the most advanced economies in the world, but Trump announced in a Tweet, in February, that he wants America to be a step ahead by adopting 6G 'as soon as possible'. The only problem is, there's no such thing as 6G. Australia is only just announcing the first 5G broadband plans, with cellular network coverage continuing to roll out throughout the year and similar release timeframes are expected in the US. 6G on the other hand is nothing more than a conceptual project by researchers at Finland's University of Oulu that will: "emerge around 2030 to satisfy all the expectations not met with 5G".

Queensland approves custom emoji licence plates

PERSONALISED PLATES QUEENSLAND GET EMOJI-ONAL.

Emoji's make a lot of sense in online chat apps, text messages and even on some Facebook posts, but one place they probably don't is on the number plate of a legally registered car in Australia. Alas, Personal Plates Queensland, the Department of Transport and Main Roads' aphilliate responsible for making the state's official number plates, seems to be giving them the thumbs-up emoji. We will concede that PPQ doesn't actually permit the use of emojis as registered characters, saving officers the embarrassment of having to call in a speeding vehicle as "Plate number: eggplant, eggplant, loveheart, eggplant eggplant", but it's not far off, promoting a 'H4H4H' plate with a 'Face with Tears of Joy' emoji on its homepage. ■



The home of technology

techradar.com

AORUS

RGB FUSION 2.0

AORUS GAMING SERIES

TEAM UP. FIGHT ON.

GIGABYTE